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THE IRRIGATION AGE

(ILLUSTRATED)

JANUARY - JUNE, 1896

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CHICAGO

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" 20	2	1	8 " 16	7	2	200	60 00	75 00
" 25	$2\frac{1}{2}$	1	10 " 24	11	2	225	66 00	81 00
" 30	3	$1\frac{1}{4}$	18 " 35	15	2	250	75 00	90 00
" 40	4	2	35 " 75	30	2	550	120 00	110 00
" 80	8 or 10	4 or 5	150 " 350	150	3	3000	450 00	500 00

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THE IRRIGATION AGE.

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CHICAGO, JANUARY, 1896.

NO. 1.

ILLINOIS LEADS THE WAY.

IRRIGATION NECESSARY IN THE MOST FERTILE STATES.

IRRIGATION in Illinois is an established fact, and the advantages of this safe, sure method of farming are demonstrated in a most substantial way. Fertile as is the soil of this State and beautiful as are the crops when there is sufficient rain, it is conclusively shown that crops on irrigated land are fourfold greater; and when there are seasons of drought, and the crops on the old-fashioned farms prove partial or total failure, there is of course no longer any comparison at all between the two systems of farming, for irrigated crops never fail.

The drought of the past season, with its disastrous effects for the farmers of this and other central Western States, together with meager reports of most wonderful results on an irrigated farm near Kankakee, Ill., have combined to create a perfect furore among the agricultural classes. Farm-owners and working farmers from long distances visit this irrigated farm, and letters and inquiries from points in this and other States are so numerous that they can not be answered.

One day recently a representative of *THE IRRIGATION AGE* made a flying visit to Kankakee, and drove out to the irrigated farm. It is a State institution, and thus Illinois has officially adopted irrigation, and points out the way of salvation to all her sister States of the central West, the East and South. It is evident that the age of prayers for rain is a period of the past.

In 1894 the crops on the 1,000-acre farm of the Eastern Illinois Hospital for the

Insane were ruined by drought, and the hospital management paid out \$15,000 for vegetables, fruit, etc. The past season of 1895 was again dry, but there was such an abundant yield that not a dollar will have to be expended, and 2,000 bushels of turnips alone have been fed to the cattle. Irrigation of 150 acres, used for garden and orchard, brought about the change, and the expenditure for the irrigating plant, making watering possible, was only \$1,500. The innovation was suggested and urged by Dr. Clarke Gapen, the superintendent of the asylum, who is a reader of *THE IRRIGATION AGE*, and through the co-operation of the board it was carried out.

Numerous questions were asked by the visitors, all of which were cheerfully answered by Superintendent Gapen and his assistants as they showed the people around. In 1894, of forty acres planted to potatoes, the crop did not return sufficient to make good the seed. The cabbages were dried up, vegetables of all kinds were little better than stalks, and small fruit withered, all because of the lack of water. It was this condition of things that prompted the resort to irrigation, and the great success achieved commends the decisive step taken.

The work of preparing for irrigation was commenced late in the spring of this year. The plan was to extend the regular water works of the institution so as to irrigate 150 acres of land for garden and orchard. Pipes were laid from the Kankakee river, and ditches dug in the tract.

The pumps lift the water about twenty-five feet. A Blake pump, with a capacity of 3,000,000 gallons per day, and a Worthington pump, with a capacity of 2,500,000 gallons per day, now furnish the supply of water for 3,000 patients and the entire institution, and also the water for irrigating 150 acres of land, 100 acres for garden and 50 acres for orchard. A 10-inch pipe that carries water to the hospital was utilized for a distance. Then 1,200 feet of 6-inch main was laid to the highest point on the grounds of the asylum, about half a mile west of the buildings. This point is twenty-five feet above the average level of the river. From the summit, 2,000 feet of 4-inch and 800 feet of 3-inch pipe were run to various parts of the garden. At intervals hydrants were put in. A ditching plow was used to make the furrows where water was to be turned on, and these furrows were connected with the hydrants by short sections of hose. The pumps are only run to their full capacity when the irrigation work is being carried on. They consume from twelve to fifteen tons of coal per day when running at full capacity. It was about the first of June before the mains and ditches were ready. Superintendent Gapen is confident that if they had been finished a couple of weeks earlier, the results would have been still more remarkable. The land was given but one thorough irrigation during the season. After being pumped to the highest point, the water is run in open ditches over the greater area of the tract. About a month was required to cover the 150 acres. Certain sections of the garden, such as the onion bed, were flooded instead of being ditched. By a system of sheet-iron dams, the streams in the ditches are kept under control and the water is sent just where it is wanted. The ditches are small, and when the pumps are working at full force, the depth of the water in most of them is but two or three inches. The superintendent estimates that 100,000 gallons of water to the acre are necessary for the season.

The visitors were astonished to learn that seven crops of peas were raised. Of radishes and other vegetables there were also tremendous crops. Raspberry and blackberry bushes which were set out in the spring bore fruit. Of 1,000 cherry trees planted this season not one died. "Our potato patch," continued Superin-

tendent Gapen, "was the finest in Illinois. In one patch we had 120,000 heads of cabbage, every one of them huge, hard and perfect. Last year we had to buy 100 carloads of vegetables; this year, through irrigation, we have such a quantity that we can hardly get rid of it."

The superintendent added that he was ably assisted in the practical irrigation work by Mr. W. F. Harris, formerly of Orange, Cal., who is familiar with irrigation from a long experience in his native State.

The party were then escorted to the office of Dr. Gapen, where they were shown a tabulated list of the products grown on these 100 acres of irrigated land in 1895, and there was not only astonishment but the greatest enthusiasm for irrigation. The figures were:

	Acres.	Barrels.
Beets.....	4	1,960
Cabbage.....	15	1,498
Cauliflower.....	3	81
Cucumber (bu.).....	$\frac{3}{4}$	184
Lettuce.....	$\frac{3}{4}$	101
Watermelons (No.).....	7	13,055
Muskmelons (No.).....	7	2,940
Onions.....	3	255
Peas.....	5	259
Radishes.....	3	804
Tomatoes (bu.).....	6	1,360
Turnips (bu.).....	15	3,085
Potatoes (bu.).....	25	3,714
Greens.....	$2\frac{1}{2}$	500
Rhubarb.....	$\frac{1}{2}$	261

The value of these vegetables was generally \$15,000, and as the gardens elsewhere were failures, on account of the extended drought, it is practically a gain of \$150 an acre for the small outlay for the irrigating plant.

SPREADING LIKE WILDFIRE.

When asked for his opinion as to the future of irrigation, Superintendent Gapen said it was bound to become general; that the large number of letters that come to him show that the irrigation movement is spreading in the east like a prairie fire. He believed that "THE IRRIGATION AGE, the pioneer in this new field of an old science, is destined to have a much larger circulation east of the 100th meridian than west of it, as there will be a larger number of farms irrigated east of that line." He added, "I can see no reason why farmers should sit idly by and see their crops ruined by droughts. In this climate I should say that two irrigations during the season would be necessary,

VIEW OF PORTION OF IRRIGATED LAWNS, GARDENS AND ORCHARDS,
ILLINOIS EASTERN HOSPITAL.

though, of course, this would depend on the amount of rain. I call my system 'supplemental irrigation,' as it is intended to supplement the rainfall. I don't know, however, but 'supplemental rain' would express the situation better, for the irrigation is sure and the rain is not. Almost any farmer who possesses a well or spring can, for a small cost, comparatively, insure his crops against a dry season. Water will run down hill, and the chief thing to take into consideration is to get the water to the highest point on the land. I estimate the entire cost of a plant—engine, mains, hydrants, etc.—to be about \$15 to \$20 per acre irrigated. This is the first year's expenditure. After that the expense would be only for fuel and labor. I believe the increase in crops the first season would more than repay the entire cost of the plant. It would be possible in some cases to use windmills for pumping, but small steam or oil engines are not expensive. In the case of the asylum, we have a pumping capacity of about 8,000,000 gallons of water per day for the institution, so we did not find it necessary to put in additional engines. The annual maintenance of an irrigation plant similarly situated to ours, including the coal used to run the engine, and an engineer for the same, would not cost more than \$1 per acre."

The superintendent believes that the interest awakened in Illinois in regard to this question, on account of the severe droughts during the past few years and the success met with on the asylum farm, where irrigation is demonstrated to be a great success, will lead to an immediate

great advance in this line of work, and that within a few years every farmer will have an irrigation system, or will irrigate his orchards and gardens from wells. In many places a few farmers can join together and take water out of a stream, as was formerly done in Utah and other sections of the arid region.

CHEAPER PUMPS—INCREASED VALUE OF FARM LANDS.

The superintendent predicts such a demand for cheap pumping plants, able to deliver water at a relatively small cost, that it will lead some inventive genius to make a pump at far less cost than anything on the market at the present time. He would not advise any farmer, however, to wait for cheaper machinery, as the value of one crop, lost for the want of irrigation, will more than pay the cost of pumps and windmills at the price they are now sold.

Asked what would be a fair statement of the increase in the value of farm land on account of the irrigation system, Superintendent Gapen replied that the increase in products is four fold, and, estimating on this basis, land which was valued at \$100 an acre without irrigation would be worth \$500 an acre with it.

That the people of the State of Illinois will feel proud of the sagacity and enterprise of the superintendent and board of trustees at Kankakee goes without the saying. They have set an example which will be followed. Illinois leads the way. The farmers of the whole country will fall into line.

WATER SUPPLIES FOR IRRIGATION.*

BY F. C. FINKLE, C. E.

THE first duty of an irrigation engineer who is intrusted with the work of designing an irrigation system for a tract of land requiring irrigation is the examination of the proposed water supply, if one has already been proposed, or an examination for the purpose of finding an adequate and reliable water supply, if this point still remains unsettled at the time of his taking charge.

The choosing of a water supply for an irrigation system is a matter which requires the greatest skill and care, as upon it depends the success or failure of a system, no matter how well and carefully all other things may be provided for in the construction of the plant. Mistakes in the location of waterways and conduits and errors in designing structures, while they are sometimes serious on account of the expense necessarily incurred in correcting them, are not *per se* a complete cause for the absolute failure of an irrigation system in which they occur. But a real mistake in the choice of a supply of water for a system is invariably a sufficient cause for the total failure of the enterprise. There are of course exceptions to this rule in a few cases, where, in the event of the failure partially or totally of the water supply already planned, another supply can be obtained by adding to and extending the works already constructed. But these exceptions are so rare that a mistake in the choice of a water supply can be said to be fatal to the success of an irrigation enterprise, and the greatest care should always be exercised by the person having these things in charge to avoid anything in the line of a water supply that partakes of the doubtful.

The total quantity of water required is the first thing to be accurately determined. As the amount of water to be carried determines the size and character of the conduits and other necessary works, it is the first thing we must have finally settled before beginning the preparation of plans and specifications or the preliminaries of construction.

The amount of water needed at the head

of the canal or other conduit is really the point to be kept in sight, as there is generally a considerable loss in carrying the water. After the quantity of water required to be delivered at the land to be irrigated has been settled it is necessary to determine how much will be the loss in transmission from the point where the water is taken into the conduit to the point where it is to be applied to the land. A survey of the line—a preliminary or reconnaissance survey is usually sufficient—should be made to determine as nearly as possible the character of conduit to be adopted. When this has been done the loss of water by percolation, evaporation or from other causes can be determined and added to the supply which it has been decided it will be sufficient to deliver for the proper irrigation of the lands to be served by the proposed system.

The amount of water required for an acre or other unit of land measure is called the duty of water. The duty of water necessary for the tract to be irrigated must be carefully determined before the needed amount can be stated, and this should be done before the loss in transmission is calculated. The duty of water is in itself a very comprehensive subject and, as such, will be discussed in a succeeding chapter especially devoted to that subject, and the rules governing the loss of water in transmission will also be carefully discussed hereafter in the chapters dealing with the different kinds of conduits.

Another question the solution of which requires careful study is the season of the year at which irrigation is necessary. The problem of a water supply must be carefully studied in connection with this question.

The irrigation season in different localities varies as to the time of the year at which it occurs. As a general proposition it may be stated that the irrigation season occurs when crops are growing and maturing, but this does not fix any definite time for all localities, as the crop season follows the climate and occurs in different latitudes and longitudes at varying times of the year. The location of a region with

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reference to bodies of water, mountain ranges, etc., also has a marked effect upon climate and consequently affects the crop season and time for irrigating to quite a considerable degree. Again a portion of the season at which crops are growing may be abundantly supplied with moisture by nature, while the portion which is deficient in natural humidity may require more or less irrigation. It therefore becomes a matter of the highest importance to study conditions and definitely fix the time of the irrigation season in a locality for which a supply of water is being sought. If this is done much time and labor will be saved in analyzing and studying the water question, as the investigations can be confined to a stated period of the year, and ignored as to the time when we are aware that no water will be required.

LENGTH OF IRRIGATION SEASON.

While the time of the irrigation season varies in different localities, the duration of the period in each year when irrigation is necessary varies even more. In cool climates crops grow and mature very slowly, while in warm regions their progress is more rapid. As a perfectly natural consequence to this the irrigation season in one place may be of double the length that it is in another. Some crops require a longer period for their growth than others even in the same locality, and frequently two crops of different kinds are taken from the same land; especially is this latter statement true in relation to lands lying in the tropical and semi-tropical zones.

All such matters will have to be carefully studied and determined in reference to any particular locality, before the extent of the water supply needed can be fully ascertained.

In such investigations, the doubt, if any there be, should be given to make the water supply safe and ample, so that no error is committed for want of conservative judgment and action. If different crops can be grown the amount of water should be figured for that particular kind of crop which requires the most water and consumes the longest time for its growth; and if two crops can be raised on the same land each season, enough water should be provided so that this can be done if desired. Every precaution should be taken to make the water supply ample for all required purposes and possible future de-

mands upon it, to the end that the lands watered will be able to support the largest possible population and yield the greatest production.

As will be seen later on, the length of the irrigation season does not affect some classes of water supplies, such as running streams, where it is only necessary to determine the minimum flow of the stream during the period covered by the irrigation season. But on the other hand it is a most important consideration in some cases as for instance in the case of storage reservoirs, in which the water is collected during one part of the year, when no irrigation is required, and expended during another part of the year, i.e. during the irrigation season.

The physical conditions affecting the question of the selection of a water supply are many, and can only be determined by careful observations and accurate surveys. They are not the same for all sources of water supply and can therefore be best discussed hereafter in connection with the separate discussion of each mode of water supply known for irrigation purposes.

CLASSIFICATION OF IRRIGATION WATER SUPPLIES.

The different classes of water supplies for irrigation purposes may be grouped in two main divisions: (1) Gravity Supplies; (2) Pumping Plants.

A gravity supply is any water supply, which has sufficient head or elevation to enable the water to flow and be discharged upon the land where it is to be used for irrigation without the application of power for raising it above its level at the point of diversion. A pumping plant for irrigation is used only where the land to be watered lies at such an elevation that the supply of water proposed for its irrigation can not reach it without being raised by means of power.

Gravity supplies for irrigation come from a number of different sources, the principal of which are: (1) Flow of natural streams. (2) Underflow of rivers or creeks. (3) Storage reservoirs. (4) Springs and swamp lands. (5) Artesian wells.

Pumping plants may be erected to pump water from any of the above sources, when the water from them is to be used on lands which are higher than can be

reached by gravity flow unaided; but this is seldom done, as water supplies of the above character are generally valuable on lands lying below their level.

Pumping plants for irrigation purposes are profitably employed in raising water from wells only, and in other cases are very rare and exceptional, being used only where a small quantity of water is required for land above a regular gravity system, or where hydraulic power is available as a motive power.

RELATIVE VALUE OF DIFFERENT GRAVITY SYSTEMS OF WATER SUPPLY.

No inflexible statement can be made saying that any one of the sources of gravity supply named above is the best, nor is it possible to arrange them in the order in which they are to be preferred without the addition of some qualifying expression. It may be said, however, that where a supply can be obtained by simply diverting the water from a running stream, which contains a sufficient supply of unappropriated water, this is the wisest thing to be done rather than to search for a source of supply, which will require considerable money for its development. Still this phase of the question is of importance to the original projectors of an enterprise only, as it does not signify that the water is any better or more valuable to the irrigators, who will subsequently own and use it, than if it had been originally obtained from a more costly source. The value of a water right depends upon its infallibility quite as much or more than upon its cheapness in first cost, and it is better to have water from an undisputed and unfailing source, which it has cost considerable to develop, than to overappropriate natural streams and fall heir to the subsequent evils of litigations and partial failure of the supply.

From what has already been adduced in the preceding paragraph we can readily conclude that the flow of a natural stream is a very desirable source of water supply for a system of irrigation works. This is certainly true beyond any question or doubt, providing always that the flow of the stream, where the same is to be diverted, is ample to give the required amount of water. After having investigated and finally settled upon the amount of water requisite to make a projected system adequate for the area to be irrigated,

it therefore becomes equally necessary to study the stream and determine with the same degree of thoroughness what its flow has been for a number of years past and what we may safely conclude will be its discharge in the future. In order to do so a familiarity with streams and the laws governing them in general must be one of the accomplishments of the irrigation engineer, and in the succeeding paragraphs we will therefore briefly discuss the natural philosophy of flowing streams.

THE ORIGIN OF STREAMS.

Certain conditions of physical geography are necessary to the existence of flowing streams of water in a country. The land must consist of mountains, hills, valleys, plains, etc, combined in such a manner as to cause differences in elevation and inclination to the surface. The extent of any region having a range of elevations from the highest mountain to the lowest plain or valley, all falling in the same direction or in different directions, which ultimately unite into one valley or basin, is one of the most important conditions determining the length and size of streams. Other important conditions are of a meteorological nature and relate to the evaporation and condensation of water and the movement and temperature of atmospheric currents. Water readily changes from its liquid to its vapory or gaseous state through subjection to heat. Heat applied to a drop of water whether it is exposed to the rays of the sun or to an artificial heat soon causes it to disappear into the surrounding air. This is due to the expansion of the liquid and its consequent conversion into a vapory substance lighter than air, which readily mingles with the atmosphere, being controlled and moved by it, until by condensation it again becomes heavier than the air and descends to the earth. The heat of the sun is constantly exerted to expand water exposed to its rays, and its power causes evaporation from the surfaces of bodies of water and from the water contained in organic and inorganic substances in the form of moisture.

The vapors thus formed fill the atmosphere and move with the prevailing winds until they reach higher altitudes, where the colder air condenses them, or until a cold current of air meets a warmer one, which is heavily laden with vapor, and

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causes the condensation and subsequent reappearance of the evaporated water in the form of rain or snow.

We now have all the conditions necessary to the creation of a flowing stream of water. As soon as the ability of the soil to absorb the rain or melted snow is exhausted, it begins to flow along the inclined surface, always seeking its lowest level, until the union of one small stream with another in a common channel produces a creek or river of importance.

ABOUT RAINFALL IN GENERAL.

Owing to the irregularity and unevenness of the surface of the earth, causing differences in the area and elevations of watersheds, and variations in the temperature of the atmosphere together with the varying distances between bodies of water, the length, size and the volume of flow of streams at different seasons of the year is a matter of much uncertainty. It depends upon the amount of rainfall on the area tributary to the stream and its distribution throughout the year either by the constant recurrence of rains or the melting of accumulated snows. In the case of large rivers, where the volume of flow is derived from a large watershed having a copious rainfall, the supply is probably so much greater than all possible demands, that investigations of the rainfall are unnecessary. But such rivers do not frequently exist in arid regions, and the irrigation engineer is generally called upon to obtain a supply from streams having a limited as well as a poorly and unevenly watered drainage basin.

In such cases it is necessary to proceed with the utmost caution, and to carefully investigate the amount and distribution of

the rainfall throughout a sufficient number of years to determine the available supply of the stream.

VALUE OF STATISTICS.

All civilized countries have statistics of the rainfall on its principal river basins and watersheds and of the flow of its principal streams at different seasons of the year. The value of these statistics, of course, depends largely upon the efficiency of the service under which they are prepared, but it is safe to recommend the reports of the signal service and meteorological departments and the reports of the geological survey of most countries, as a source from which a large amount of reliable information can be drawn regarding the capacity and discharge of the principal streams of those countries.

Statistics prepared by private individuals and corporations, who are or have been the projectors and owners of water works or irrigation enterprises, may be said to be equally as valuable if not more so than those prepared under government supervision, and when they are obtainable much valuable information can be obtained from them. But as a rule these only relate to watersheds or streams which have already been improved or appropriated, and are useful only in making examinations and reports on existing works, or for drawing conclusions and making estimates on works projected in the immediate vicinity. No tables of statistics relating to rainfall or the areas of drainage basins of streams will be reproduced in this work, as this would simply be copying public records, which are open to all, and would occupy space which is more valuable for the discussion of principles.

(To be continued.)

THE ART OF IRRIGATION.

CHAPTER VIII. CHOICE OF METHODS (CONTINUED). PREPARATION OF THE GROUND.

BY T. S. VAN DYKE.

NOTE—[As the publication of this series has been suspended some fifteen months the reader may have to go back over some of the ground passed over before fully understanding this. The first seven chapters were mainly introductory, dealing with the errors of the early irrigators to a large extent because experience has shown that almost every one if left to himself will follow exactly in their footsteps. The study of error is as valuable as the study of going right, and every one should read the history I there gave. Those chapters contained also a large amount of facts necessary to a full comprehension of what is to follow and too numerous to repeat. Those who have not read them must therefore attend more closely to what follows, for it will be the more practical part, or how to do it as distinguished from how you don't do it.]

Next to the quantity of water at your service, the size of the irrigating head in which you can have it, and the length of time you can allow it to run, the slope of the ground becomes the most important factor in determining the method of applying water. If the slope is great you can not flood by checks of any reasonable size. If they are very small their number becomes a nuisance in making and in handling the water from one to the other. If not small then the water stands too deep and too long in the lower part; and too much puddling, with compression of the soil, is the consequence, besides uneven wetting. All these are to be carefully avoided where possible. The slope may be so great as to compel you to terrace if the nature of the product will justify the expense. If the soil is easily worked it may pay to terrace some on a very light slope, making the terraces very broad. This may pay even for alfalfa. If terracing will not pay you may then be driven to the use of basins or rings around the tree or vine where the slope is great. On such ground you can do little with large heads of water for a short run but must in some way work with small streams with a long

run. And as a rule it will rarely pay to bother with anything but trees, vines or vegetables on ground having very much slope. Alfalfa and grain can be grown on it but they will not generally pay except for home use on a small scale.

Good drainage in irrigation is almost as essential as water. Where the drainage is bad you must avoid flooding if possible and use small streams or you may have a sour, cold soil, with alkali perhaps appearing on the surface when it dries and becoming constantly worse. On the other hand, if the ground contains alkali, which rises to the surface in quantity sufficient to be injurious, flooding is often the only way it can be removed. If there is sufficient slope to carry water rapidly off, ground that has become badly alkalied may be put in good condition by a quick flooding that will dissolve all the alkali on the surface and then letting it run off as fast as possible. And if very liable to alkali it should be laid out so that it can be flooded in this way if necessary. But drainage must still be provided if possible. You must remember always that in irrigation, however slowly or carefully done, if done on a scale large enough for a commercial success, a much greater quantity of water is put upon the ground in a given time than is usually done by the clouds even when unusually generous. And in the course of the year one who has any kind of a respectable water supply will generally put more into the ground and have more run off of it than will be the case from rain in the wettest parts of the country. Therefore there must be provision for the water to run away beneath if possible, or, if the soil is not naturally well drained, care must be used in putting water into it so that there be no excess. Waste water ditches above ground must be provided for what runs away and all rights of way should include these for individuals as well as companies.

There is a distinction between "alkali land" and land liable to alkali that should be kept in mind, though the difference is

none too easy to define clearly. Almost any land forms some alkali in every country, and under bad drainage may show too much when irrigated. The spots of natural alkali seen on the surface of the ground in some of the deserts are instances of this. They are not found where the soil is perfectly open below with good water beneath. There is somewhere a subsoil of some tight material that stops the alkali as it is carried down by the water from some occasional clondburst or unusual rain. Then the evaporation brings it again to the surface where it is left as a white powder. Alkali is not often in the

Oranges do not seem injured by considerable of it, though ground so badly drained as to make alkali possible will not generally produce a fine orange. But the possibility of alkali is always to be considered in irrigation; for under ordinary treatment it grows worse instead of better. Thousands of acres in California that were once fertile land, showing no trace of alkali on the surface, but having it in the subsoil, have had it brought to the surface by bad irrigation and defective cultivation and drainage and are now about worthless though they may be reclaimed. But ground with an open soil and good sheet

SPECIMEN OF VERY GOOD FURROW IRRIGATION. A YOUNG ORCHARD WITH GROUND BETWEEN ROWS OF TREES PLANTED WITH VEGETABLES.

sheet water below but is more commonly in subsoil of some tight material from which it is carried up and down alternately by capillary attraction and leaching.

"Alkali land," as it is called, is land already so full of alkali as to show plainly either in efflorescence or coloring standing water on the surface. Such land is not necessarily bad. If the alkali is not too strong on the surface the soil will raise many things as well as any land. When once well started alfalfa will stand considerable of it. So will corn and many kinds of vegetables, especially beets. So will many kinds of fruits, especially pears.

water beneath, and hardpan lands with a slope of fifty feet or more to the mile have been worked for years with the worst kind of irrigation without showing a trace of alkali.

Your choice of methods will also depend upon your object in irrigating. Almost every rule and caution that this work contains may in some places and for some purposes be disregarded. Are you irrigating for profit or only to raise something for your own use? If for profit it may pay you to do the best work possible. For remember that good irrigation is often as far superior in results to bad irrigation as

bad irrigation is to no irrigation. But not always. If the best work costs too much and the market is unsteady there may be too much risk in this. You may be able to do one kind of work yourself but with another may have to hire help or buy material. And if you are working the ground merely for your own convenience and care little for looks bad work may be good enough. Suppose you have a bed of onions for your own use. If any way of injuring them materially by bad wetting can be devised I have not yet been able to discover it. By good work you might get a better crop and if you were raising them to sell it would doubtless pay you to do better work. But you can not much affect the quality of the onion by any style of applying water and with any reasonable amount of it you will have from a small piece of ground more onions than you can use. Out of pure curiosity I have made desperate efforts to damage the radish with bad irrigation; but as long as it gets enough water the quality is hard to injure and the yield from a small bit of ground will be large enough, if the weather is right. It is much the same with beets, cabbage, carrots and all tough vegetables. But if you are raising stuff to sell and have a sure market the very best work will generally pay and for all high grade products is quite certain to.

The rainfall and its distribution as well as the kind of weather that generally follows rain will also have an important influence upon your choice of a system. In much of Southern California, the ground holds moisture well and the rainfall averages about eighteen inches with a minimum of about seven happening only at very long intervals. Good crops of grain on a rainfall of only twelve inches, some of which by coming too early is practically lost, are a common sight in short years. And with good summer following fair crops are raised on the very minimum of seven inches. Thirty bushels of corn on upland on which not a drop of rain has fallen since the seed was planted are common on well plowed and cultivated uplands in average seasons without a particle of irrigation. And where the ground is well cultivated good yields of fruit are common even in the average years if the trees are not too old or too heavily loaded. The dry period is generally more than six

months but with good cultivation the moisture retained in the ground from the winter rains carries most things through quite well. I am fully aware of how monstrous these statements will appear to many, but the truth can be had from hundreds of places, and not for one year, but for over a dozen.

Under such conditions vegetation may need but a little drinking water and any way of supplying it may be good enough for the purpose in hand. The soil may be nearly moist enough to enable the roots to feed and may need but a trifle more. Such is the case in the greater part of the States east of the Mississippi where irrigation will certainly be used before many years to carry many products over the periods when the rainfall is too short and where it would pay them to do it now if they only knew it. But it would be folly to put in the expensive systems necessary in those sections where the rainfall is of little or no use, and where the air is so much hotter and drier that vegetation demands more water to evaporate through the leaves. And it might be equally unwise to do the fine work that for high grade products pays so well in California. The only trouble is that from fair results from careless work too many conclude that it is good enough anywhere.

GRADE THE LAND.

In whatever way you apply the water it will pay you to have the land so graded to a uniform slope that the water will run in all directions at about the same velocity. This will be true if you are to run it only from one small basin to another, still truer if you are to run it in large heads from check to check, and still more important if you are to run it in a large number of small streams across the tract. You will get back all it costs in time and patience to say nothing of the greater uniformity of the wetting, and the greater ease of cultivation and consequent better results. It is almost impossible to make people realize this until there has been considerable loss, and often not until the place is planted in an orchard that is paying just a little too well to take out, where the trees are too old to allow good grading between, and yet in yield are steadily falling behind a well-graded orchard beside it. No matter how even or level land may appear it

is almost never even enough to irrigate. The result is a swamp here and a dry ridge or hump there. When the swamp is dry enough to cultivate the other is too dry. Uniform moisture throughout the whole is impossible while the work of handling the water and the cultivator afterward is often doubled.

This grading is not nearly so expensive as one would suppose from looking at the places of those who have plenty of money and want everything symmetrical. The ground does not need leveling or anything near it. It is not of the slightest consequence whether the water is to run straight across a field or slanting. Nor, aside from looks, is it necessary that the slanting course should be the diagonal of the field. Nor need the furrows be straight or trees or vines planted on perfectly straight lines. Nor need the whole place be graded to the same plane. You may have two or more slopes even on a five-acre tract. And no inconvenience from having too many faces could equal the inconvenience of leaving the ground in its natural condition. In whatever direction the water is to run it should run at about the same speed whether it is to be in small streams or big ones. And if the water is to stand on the ground, as in flooding, the depth should be as nearly uniform as is reasonably possible. These are cardinal principles and the man who neglects them will regret it, perhaps when too late.

This grading can be cheaply done if the ground is in the right condition of moisture from rain, properly plowed and a good machine used. It can be made very expensive by ignoring these conditions. It can not be well done with small scrapers that bounce. A road grader does very well and some scrapers are made purposely for this work. But for a few dollars one can make one that will do as well as anything if heavy enough and enough horses put to it. Two long heavy beams, the longer and heavier the better, should be well bolted into an A shaped scraper: An iron shoe along each lower edge should be attached and made so as to cut. The lugs to which the drag chain is to be fastened should be several in number and running down each side of the apex, so that in a moment either edge may be set at any angle to the course of the team. This will smooth down almost any ground

that has been well plowed, and, cut down considerable that has not been. If weighted with sand bags and drawn by several horses it will cut wet ground quite well without plowing. If long enough, heavy enough and used long enough it is certain to put an even slope on almost any soil sufficiently open to be well drained. Where there are ravines to fill or boulders to remove the expense is of course increased and one must then begin to inquire whether the value of the product is great enough to justify the use of that piece of land. But do not solve the question the other way, as many do,—decide they will use that land but that the cost of grading is too great to put it in proper shape. As a rule if it costs much to grade that proves it is worth little without the grading. In such cases get another piece. Some of the best orchards in California cost one hundred dollars an acre for the grading alone. Some now bearing the heaviest crops of the finest oranges and lemons look smooth as silk on the surface, yet two feet below big boulders are so thick that you could not take out a cubic yard of them and repack them as closely as they are there in place. Ravines ten feet deep in places have been filled with the loose rock from the surface and covered over with dirt. Warmth and perfect drainage make this ground valuable for high grade fruits, fertility being of trifling importance beside these conditions, though even this ground is much more fertile than one would suppose. But for every dollar the owner laid out on this ground he will get back five or ten. To have attempted to irrigate it in its natural state would have been almost madness. The same principles apply, however, to ground that looks all right and needs but little work. The difference is only in degree, and if but little work is needed it is all the more reason it should be done. If much is needed it only proves that the land is almost worthless without it and if the crops won't justify the expense you should get a piece where they will.

You must not be led astray by talk about different systems of irrigation. Nothing is more absurd than to hear some one talking about "the diagonal system" for instance because the furrows are run diagonally across the field, or flooding

called a "border system" or a "plat system" because the checks are made small, or something called "subirrigation" because the water soaks upward from underneath, either from general soaking of the subsoil from big ditches on porous soil, or from the upward seepage from small furrows made very deep so that the plant stands on a high ridge between them. All this multiplication of nonsensical distinctions is confusing. Great numbers of such distinctions have been made and most of them are as valuable as the old distinction between *tweedle dum* and *tweedle dee*. When familiar with the principles on which the value of all of them depends you will see that systems are very few in number and very simple. And even then you will find that some are

used, not because they are the best, but because the cheapest. Alfalfa for instance can be raised as well, and on some soils better, by watering from many small furrows. There is no better alfalfa in the world than that raised in this way. If the water supply allows you to flood it will generally allow you to irrigate in this way. If you are raising only an acre or so for home use, for a milch cow and a few chickens, etc., it will probably be cheaper and easier to use the small furrows, as is done on thousands of small patches in Southern California. But if you are raising large crops in large fields, then the economy is generally the other way, and where the land is very flat it becomes by far the cheaper method.

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THE CODY CANAL IN WYOMING.

By ELWOOD MEAD.

AT the eastern base of the Shoshone mountains, where the river of that name emerges from the shadows of its canons to cross the plains of the Big Horn Basin, is a series of terraces left by the receding waters of some prehistoric lake.

These lie one below the other along this stream for forty miles, extending back from it two to ten miles. So uniform is the contour of these successive steps that in many places water will follow a surface furrow along section lines across an entire township. The abundant water supply of the river, the fertility of the soil, and the ease with which water can be distributed, give these slopes a peculiar fascination to the practical irrigator.

Ever since the advent of the first emigrant this tract of land has been a source of longing to the homeseeker. As the possibilities of this region became better understood its attractions have increased until it has become generally known and regarded as the most extensive and desirable body of irrigable land in the state.

At present the entire tract is arid and unoccupied. Even the speculative land grabber, masquerading as a homesteader, has not found it worth his attention. The prospect of diverting the river which flows through it has seemed so remote and the obstacles so formidable that it has been

considered a project for the next century rather than the present. The Shoshone river from where it leaves the mountains until it passes the lowest terrace is hid below the nearly vertical rock walls of a canon almost as deep as it is wide.

To surmount these rocky slopes with a canal is out of the question. To reach these lands in any manner is equally beyond the reach of the individual settler. Nothing but aggregated capital and the best engineering skill will answer. Neither of these were available under the public land laws which make canal building a lottery in which the builders buy the tickets and the settlers, on the land reclaimed, draw the prizes; but with the passage of the state law accepting supervision of one million acres of land for reclamation the opportunity was open to invite the joint efforts of the capitalist and colonist to effect its transformation.

This law came at an opportune season. Increasing settlement has demonstrated the wonderful fertility of this soil and has shown that the shelter afforded by the snow-clad mountains which surround the Big Horn basin gives to this region a local climate, milder and more uniform than is enjoyed by any of the surrounding country. The curative virtues of the medicinal springs which gave this river its

original name are becoming widely and favorably known; four thousand acres north of the river have been located as gold placers which can only be washed by a canal high enough to irrigate the entire tract.

The region surrounding the headwaters of the Shoshone river is one of the greatest game preserves in the Rocky mountains, and is destined to be one of the Nation's pleasure grounds in the near future. The unique grandeur of the scenery of the Hoodoo or Goblin mountains will become more and more attractive as new trails are opened into their hitherto inaccessible heights. One serious drawback has been its isolation. Fifty miles to the nearest railway station is farther than the average pioneer desires to go. Red Lodge is about that distance from the center of these lands. This objection promises to be removed at an early date; the transcontinental survey of the Burlington railway passes up the Shoshone river and the last extension to Billings, Montana, leaves it only ninety miles away.

THE PROPOSED CANAL.

These considerations have drawn the attention of the outside world, have led to three separate surveys to discover a feasible canal line, and have finally resulted in a location which while covering nearly three-fourths of the entire tract is secure and not exceptionally expensive.

The river canon is avoided by beginning the canal above Cedar mountain, the last range cut through by the river. The canal emerges from the mountains through a low pass several miles south of the river and about five hundred feet above it. This is accomplished with but little heavy work. The terraced formation extends above this mountain and the lake deposit has covered the underlying rock to a depth which affords easy ground for the required excavation. Actual construction began in September, and at last accounts about three miles had been completed, it being the intention to construct seven miles before January 1, 1896. The permit from the State Engineer's office is for a canal sixty-five feet wide and six feet deep, with a grade of two feet per mile. The portion completed is only excavated one-half this width, it being the intention to enlarge as increasing use makes necessary. In this way a large part of the con-

struction work will be reserved for the settlers who will be given preference in letting contracts therefor.

In many of its features this canal is destined to occupy a unique place among our great irrigation works. With most canals, the problem is to secure elevation, with this it is to dispose of it. The headgate is five thousand, seven hundred feet above sea level. In fifty miles the canal falls twelve hundred feet and the lower end is little if any above four thousand feet above the sea.

This excessive slope requires a series of drops. The first occurs at the pass south of Cedar mountain. Here is a vertical fall of two hundred and fifty feet, the water tumbling down a rocky slope. Nearly all the drops are arranged to occur at the passage from one terrace to the next below. In this way the expense is greatly lessened. Two of these will require the construction of chutes to confine the water in its descent and protect the canal from its erosive action; but in two others the water will find its own channel down rocky slopes, the material being hard enough to resist its erosive action. One drop occurs at the head of the ravine in which the placer deposits are found and a head of two hundred feet can be had for hydraulic mining. The first descent will doubtless soon be used for the generation of electricity for both lighting and power, as it is near the Shoshone Hot Springs and the proposed town of that name. Doubtless the entire available water power will in time be utilized.

While the headgate is on the south side of the stream about ninety thousand acres of land to be reclaimed are on the north. To reach this will require either a flume one hundred and twenty feet high, or a pipe passing down one side of the canon and up the other. The canon at the point selected for the crossing is about one hundred and fifty feet wide on the bottom and three hundred and fifty feet at the level of the proposed flume.

Between one hundred and twenty-five and one hundred and fifty thousand acres of irrigable land can be watered from this canal. If settled in small tracts it will support twice the present population of the entire State. If half is placed under cultivation it will be six times the cultivated area of the entire State in 1890.

Such a work has more than local interest. It is not only the most important irrigation work yet seriously considered in the State, but its magnitude as compared to what has heretofore been accomplished is so great as to overshadow all past efforts, and its success is destined to exercise a decisive influence on the future of the State.

In the face of the increase in population and material wealth which must accrue, the malignant and demagogical opposition to agricultural development, which has beset this enterprise and which has been so conspicuous a feature of this State's history, must cease. The effort to keep this State as an open range, to array selfish interests against the State's growth, to arouse prejudice against canal companies by demagogical appeals, has succeeded in placing Wyoming behind every surrounding State in population and material prosperity. The inauguration of this project under these adverse conditions means a different and more enlightened appreciation of our opportunities.

This project is conceived on a broad scale. A mammoth canal; an extensive area to be reclaimed; immense possibilities for material development in the generation of cheap power for mechanical purposes; the creation of important towns in what is now an unbroken solitude, and the transformation of the conditions of one of the most favored sections of the State are attractive material results, but they are equalled by the generous purpose which inaugurated this enterprise and which animates its president and leading spirit.

BUFFALO BILL'S ENTERPRISE.

"I propose to leave a monument of my work for the West by founding a colony

in the Big Horn basin which shall be to Wyoming what the Greeley Colony is to Colorado."

This statement of Col. W. F. Cody (Buffalo Bill) explains the origin and underlying purpose of the Cody Canal. While the work is intended to be a financial success, and will be managed to that end, philanthropy is to share with profit in all its transactions. It is not to be a canal to acquire title to land. The land goes only to actual settlers in tracts not to exceed one hundred and sixty acres to each settler. It is not intended to speculate on the rise in land values. Each settler pays fifty cents an acre, no more, no less. Twenty-five cents on making entry and twenty-five cents when proof is made of reclamation. It is not a canal to derive a perpetual or exorbitant income from water rights. Each settler under the canal must purchase an interest therein. Not a vague promise, such as constitutes many instruments known as water rights, but an actual proportionate interest in the work itself. The water rights come from the State, attach to the land reclaimed and are inseparable therefrom. The interests in the canal will be based on the cost of the work. It is simply capital, energy and system combined to construct the works for the settlers, who, when they are paid for, will own and control them.

If the experience of the last quarter of a century is to be a guide this canal is destined to be a success. A success because the physical conditions are favorable and because settlers are here freed from many of the economic mistakes, not to characterize them more harshly, which have marked settlement under earlier attempts at canal building on a large scale.

THE MINERAL WEALTH OF WYOMING.

BY ARTHUR W. PHILLIPS.

IN the limited space of a single article it is not possible to do complete justice to the subject of the mineral resources of the whole State of Wyoming. The storehouse of undeveloped wealth is so vast, the varieties of mineral so many, that the adequate description and handling of this subject would fill a large volume.

The writer does not pretend to be an expert in all the different mineral resources here mentioned, and is solely actuated in the penning of this article by the desire to publish to the investing public a few facts about the extraordinary opportunities for the investment of capital in developing the almost untouched treasures of Wyoming.

In this State there are mountains of the finest iron ore, vast deposits of coal, soda, gypsum, salt, sulphur, copper, lead, tin, mica and other minerals, also marble, granite, sandstone, mineral paint, fire clay, kaolin, graphite, cinnabar and magnesium. Silver is found in many places and the discoveries of gold are attracting the attention of capitalists at the present time. Very extensive oil basins exist in Central Wyoming and are now in course of development and will no doubt take the lead amongst the valuable resources of the State. For some years past operations in drilling wells have been carried on at Salt Creek in Natrona county under great difficulties, but the success which is now crowning the efforts of the pioneers in this business, is lately stimulating others to follow their example, and several strong companies are now starting in to develop oil lands in Natrona and Converse counties. The oil obtained from wells and from oil sand near the surface in these two counties is truly remarkable, considered from any standpoint. Not even kerosene is found in any appreciable quantity in this oil, to say nothing of the lighter products. The average Pennsylvania oil produces from 40 to 70 per cent kerosene, while the Wyoming oils contain 90 per cent of high grade lubricants. This oil is beyond question the best crude oil for lubricating purposes that has ever been discovered.

The oil produced at Salt Creek is a dark olive-green color, and has been tested in every way, from the farmer who uses it on his mowing machine and his wife who uses it on her sewing machine to the locomotive engineer who puts it in competition with the high grade manufactured lubricating oils of the East. All opinions are the same, as to its being superior in its crude state to the best Eastern lubricating oils, which retail at \$1.00 per gallon and upward.

The present wells are fifty miles from the railroad, and every barrel of oil is hauled by wagon over rough roads at a cost of over \$2.00 per barrel, but even at this rate the business pays well, because of the superior quality of the oil.

During the past year a refinery has been erected at the railroad at Casper, and every grade of oil is turned out, even to the finest watch and spindle oils, without adding any animal or vegetable oils. The quality of the Wyoming oil is superior to any in the known world, surpassing even the famous Russian or Sumatra oils in body and consistency. It is used as a lubricant for many purposes in its natural crude state, and has no equal for such purposes. Wyoming crude oil sells for \$10.00 per barrel at the railroads in Wyoming, and has never been sold at less than \$8.00 per barrel, and the demand is rapidly increasing.

By refining under distillation, and without adding any animal oils, the finest grades of spindle and watch oils are obtained. These refined oils sell at wholesale for big prices, valve oil bringing \$25.00 per barrel, engine oil \$15.00 and the finer grades even more. Crude oil, just as it is obtained from the ground, sells in Omaha for \$1.00 per gallon.

When it is considered that these wells average twenty barrels per day, and that the expense of operation of the same is very light, any one can readily figure out that profits must be enormous.

The chemical tests of Wyoming oils show that they are both illuminating and lubricating in character, the latter being the most valuable, and largely predominating, and not found to any extent in any

other oil field. The lubricating qualities of the oil found in this State have been tested by the ablest chemists of this country and Europe, and have been by both pronounced the best lubricants yet found in any country. Mr. Taylor, the chemist of the Standard Oil Company, at Cleveland, Ohio, said it was the best natural lubricating oil he had ever seen. Probably there is no scientific expert in any country whose practical experience and thorough knowledge concerning oils is superior to that of Mr. Taylor, long thus connected with the greatest petroleum oil company on the globe.

Messrs. Wyner and Harland, public analysts of London, England, report on Wyoming oils that "when properly treated by distillation the product obtained would form lubricating oils equal, if not superior, to the best vegetable or animal lubricants."

Robert Hutchison, oil refiner of Springvale Oil Wells, Glasgow, Scotland, to whom was sent a small sample of surface oil obtained by skimming a spring in a tunnel near Douglas, in Converse county, Wyoming, reports as follows: "As requested by you, I beg to report as follows respecting the sample of Wyoming oil lately handed me. Owing to want of time I have been unable to examine the above thoroughly, and so can not commit myself positively as to its quality, further than to say that the body is far in excess of any mineral oil I have ever come in contact with, and if the color of this oil comes up well in refining, it will, I believe, be *without a competitor in the market*."

"Indeed it is so heavy that it appears to me it would require to be thinned down by mixing with lighter oil. This would be a great recommendation as to its merits in the eyes of consumers. I find that the color comes up most satisfactorily by treatment with chemicals, but had I had sufficient of it I would prefer to have done it by distillation, as I am convinced that the latter method would be both cheaper and give even better results as to color. After being refined the oil has a body much superior to the best Russian oil. The practical meaning of this is, that it has a greater mercantile value than the latter oil, which sells wholesale in this country at

about £23 (\$115.00) per ton, and that, at equal price, once its merits are known, it would get the undoubted preference against the Russian. It is, in my opinion, more than probable, however, that it would be preferred to rape and even become a serious competitor with lard oil for a large variety of purposes, in which case its value would be much greater than what I have mentioned, but, taking it at the most moderate estimate, I think I am within the mark in saying that the *Russian Oil*, which has been a perfect fortune to the proprietors, *would have no chance against it.*"

The following analysis and letters are in reference to a piece of oil sand rock, 48 lbs. in weight, which was obtained from a tunnel near Douglas, Converse county, about 27 feet from the surface of the ground.

THE UNIVERSITY OF WYOMING.

DEPARTMENT OF CHEMISTRY.

LARAMIE, WYO., May 18, 1895.

A. W. PHILLIPS, DOUGLAS, WYO.

Dear Sir:—Professor Knight and I have distilled the oil from the greater portion of the rock sent, carrying the process to complete exhaustion of volatile products by heating the retort red hot. The rock carries about four per cent crude oil of high specific gravity which could be used as a lubricant without further treatment. By redistilling the oil we separated it into six portions, of which samples are sent you. The oils are all heavy, and by regulating the process of distillation for that purpose, about 50 to 70 per cent of high grade lubricating oil of a specific gravity above .880 could be obtained. The residuum would also be of value.

It is quite probable that in lower strata, or in a lower part of the same stratum, the yield of oil will be richer. If we can assist you in any way in the development of this very interesting discovery, please let us know.

Yours truly,

E. E. SLOSSON,
State Chemist.

Extract from a letter received from the State Chemist, May 23, 1895.

"The oil sand you sent me produces more, high grade lubricating oil than any other in the State yet analyzed. The value of lubricating oil increases with the temperature of vaporization and the specific gravity.

"Oil between .860 and .890 are lubricating oils for lighter machinery, .890 to .900 for heavy machinery, and those above .900 are classed as cylinder oils.

"If the distillation had been carried further the residuum would have afforded 10 per cent to 20 per cent more high grade oils, leaving a residue of coke."

The following is the analysis of the oil sand referred to in the foregoing letters:

SCHOOL OF MINES.

UNIVERSITY OF WYOMING.

CERTIFICATE OF ANALYSIS.

LARAMIE, WYO., May 18, 1895.

A. W. PHILLIPS, DOUGLAS, WYO.

Dear Sir:—Your sample of oil sand submitted to me for analysis contains the following:

Sandstone.....94.2 per cent.
Oil.....4.0%, sp. gr. .921.
Water......5 per cent.
Loss on distillation.....1.3 “

100.0

ANALYSIS OF THE OIL.

No. of Distillate.	Temperature of Distillation.	Specific Gravity.	Per Cent.
1.	Below 100 C.	.816	10.8
2.	170-220 C.	.845	14.5
3.	230-270 C.	.892	16.0
4.	270-290 C.	.910	13.3
5.	320 and above	.923	10.8
6.	Residuum		34.6
			100.0

E. E. SLOSSON,
State Analyst.

The above analysis is of surface oil, the product of the wells at a depth of 800 to 1100 feet showing no residuum worth mentioning, the entire product being composed of valuable oils.

A barrel of Wyoming crude oil, just as it came from the well, was sent to the World's Fair at Chicago where the best chemists in the world tested it fully, and it was placed in competition with all the oil products on earth. After weeks of labor these judges awarded to Central Wyoming lubricating oil the first prize over all competitors.

This field presents the most sure and attractive field for investment of anything in the West. Within the recognized oil belt here, not a single well has been put down to the adequate depth, and properly cased, that is not a producer today.

The average depth of the wells is about 1,000 feet, and their average production twenty barrels each per day. At \$10 per barrel, these wells are certainly very remunerative. The whole Franklin, Pennsylvania, field, the only lubricating oil basin in the East, produces less than 200 barrels per day, and from three to five barrels is the average yield of each well. It is not strange, therefore, that the Eastern oil man is loath to believe that the Wyoming wells are so productive.

The oil belt of Wyoming extends en-

tirely across the State. In the extreme western part of the State there are oil indications, which indicate the presence of what is termed "shale oil," of little or no value.

The next basin is known as the "Duton Basin," where three wells have been drilled, and an abundant supply of oil obtained. This oil is largely composed of tar and asphaltum, and carries a good percentage of illuminating oil. Then come the Rattlesnake Mountain and Upper Powder River basin, in which some years ago a well was begun, but never finished, although some oil was obtained which was lighter than that found further west. In this locality there are many oil springs, and where the oil runs out on the ground it forms beds of asphaltum, some of which was on exhibition at the World's Fair. The next basin is the "Oil Mountain," where some good quality of oil has been obtained. North of this locality about seventy-five miles across the Big Horn mountains lies the No-Wood basin, where the oil is of a superior illuminating character, in fact the settlers of that neighborhood use it to light their houses, in its crude state. A well was started in this field by some persons who had very primitive machinery for drilling, composed of a long beam worked by hand, which is called "Kicking a hole down." Another well has been drilled in the Powder River basin in which was obtained a very superior lubricant. Oil has also been discovered in other places within the State.

Undoubtedly the best portion of the oil fields of Wyoming, however, is confined to the counties of Converse, Natrona and Johnson. The finest grade of lubricating oil is found in these counties, and the excellent railroad facilities make the enterprise of development a feasible business proposition.

The Salt Creek wells, which are fifty miles from Casper, will shortly be connected with the railroad by a pipe line, while the oil field of Converse county is traversed by two lines of railroad, the North-Western and the Denver and Gulf railroads, which make a junction at Orin, on the southern edge of the oil basin. Douglas, the county seat, is completely surrounded by oil lands upon which active drilling operations will soon commence. At Salt Creek the principal operators are

The Pennsylvania Oil & Gas Company, The Wyoming Lubricating Oil Company and The French Syndicate. The last named is a new combination which is just starting in, with plenty of capital, which is evidenced by the excellent machinery it has purchased, probably the finest outfit that ever crossed the Missouri.

Near Douglas operations will be carried on by this syndicate early next year, as well as by New York people and a company backed by English capital. That the lubricating oil of Wyoming will be one of the principal resources of wealth to the State in the future is as certain as the fact that there is no oil found elsewhere or manufactured that can begin to compare with it for quality.

To do any justice to the many other resources of Wyoming in this article would be impossible. The coal fields, larger than any in the known world, the splendid soda deposits, the unlimited iron supply, the rich gold fields, both placer and otherwise, each requires treating by itself. Recently near Douglas some rich copper leads have been discovered, which are now being developed, mica and other minerals being found in abundance. Throughout the State there is unusual mining activity, and it will not be long until Wyoming is recognized as the prospector's paradise, and the best place in the world to invest money in mining operations.

A NEW PRINCIPLE RELATIVE TO SUB-TERRANEAN WATERS.

BY CLESSON S. KINNEY.

A new question in the history of water rights was recently decided by the Supreme Court of Utah, in the case of Sullivan vs. Northern Spy Mining Company, 40 Pac. Rep. 709. It was as to whether a person who discovers and appropriates percolating waters on public lands by digging a well to collect the water can acquire an easement and right to take and use the water against one subsequently acquiring the title to the land on which the well was located. The Court held that such a right to the water could be thus acquired. In the decision the following statutes were construed:

1. The Act of Congress of 1866 (U. S. Rev. Stat. No. 2339) which provides among other things as follows: "Whenever by priority of possession, rights to the use of water for mining, agricultural, manufacturing or other purposes have vested and accrued, and the same are recognized and acknowledged by the local customs, laws and decisions of courts, the possessors and owners of such vested rights shall be maintained and protected in the same."

2. The Act of Congress of July 9, 1870 (U. S. Rev. Stat. No. 2340) where it is further provided: "All patents granted, or preëmption, or homesteads allowed, shall be subject to any vested and

accrued water right, or rights to ditches and reservoirs used in connection with such water rights as may have been acquired under or recognized by the preceding section." The question that then arose was, is the right to use water under the facts stated, one that is recognized by the local customs and laws? Section 2780, Comp. Laws of Utah provides: "A right to the use of water for any useful purpose, such as domestic purposes, irrigating lands, propelling machinery, washing or sluicing ores and other like purposes, is hereby recognized and acknowledged to have vested and accrued as a primary right to the extent of and reasonable necessity for such use thereof under any of the following circumstances: First, whenever any person or persons shall have taken, diverted and used any of the unappropriated water of any natural stream, water course, lake or spring or other *natural source* of supply."

The Court in construing these sections said: "We think it would be a very strained construction to hold that a hole dug three feet deep, into which the waters naturally gathered, was not a natural source of supply, while it is conceded if the water came to the surface and flowed along a few feet, and was then collected in a like hole, it would be a natural source of

supply. We are inclined to give these statutes a much broader construction. In our opinion, whenever the industry of the pioneer has appropriated a source of water, either on the surface of or under the public lands, he and his successors acquire an easement and right to take and use such water to the extent indicated by the original appropriation, and that a private owner who subsequently acquires the land takes it burdened with this easement, and we also hold that this easement carries with it such rights of ingress and egress as are necessary to its proper enjoyment."

So far we believe the opinion to be correct and founded upon the great principle of priority of appropriation which underlies the system of water rights in the arid portion of the United States. But, after deciding that a person had a right to appropriate the waters of a well, and also had the right of ingress and egress over the land to and from the well, the Court adds: "This right of appropriation is, of course, subject to the rule of law which will permit the owner to sink an adjoining well on his own premises, although he should thereby dry up that of the first appropriator."

The question of percolating waters is one that is still undetermined in this Western country. The courts have heretofore held that subterranean waters running through a known channel or defined course are subject to appropriation, and that he who is first in time has the superior right to them. But in the above case the course of the waters was unknown and undefined, and the Court held that they were subject to appropriation, but also held that the appropriator's right to them might be lost by the owner of the land simply digging another well by the side of the first, and thereby draining the water from the appropriator's well. It seems to us that the opinion is inconsistent with itself. It is also inconsistent with the great arid region doctrine governing waters in this Western country. Why a person should be permitted to dig another well by the side of that of the first appropriator and drain the water from his well, any more than a person should be permitted to construct a later ditch above that of the first appropriator and divert the waters of a stream to the injury of the first appropriator's rights, we are unable to see. Cer-

tainly, waters of a natural stream and subterranean waters, whether flowing in well defined or unknown courses, are both natural sources of supply, and we think that if the principle of priority is to govern one it should certainly govern the other.

THE WRIGHT LAW.

A great deal of interest is being manifested throughout the Western States as to whether the Supreme Court of the United States will decide the Wright Law to be constitutional or otherwise. Not only is this interest manifested in the State of California, from which State the case went to the Supreme Court, but also throughout other States of the West which have adopted laws nearly similar to the one in question, and also in those States where legislation upon water rights is being contemplated.

The law in question has been held to be constitutional by the Supreme Court of California in a number of cases, but by the United States Circuit Court, in which Judge Ross presided, the law was held to be unconstitutional in another case. An effort has been made by which all of these cases, involving the constitutionality of the law, have been consolidated in the Supreme Court of the United States, and will be heard at one time, some time during the first part of the year.

The principal questions in the case are, was the property taken from the private owners by means of assessment and sale of the same with or without "due process of law" and therefore in violation of the fourteenth amendment of the Federal Constitution, and, second, was or was not the property so taken for a public use or purpose? We are of the opinion that the ruling of the Supreme Court of California was correct in the premises. And regarding the second point will say that there is no such thing as drawing a clear and definite line as distinguishing between purposes of a public and those of a private nature. Public and private interests are so commingled in many cases that it is difficult to determine which predominates. But when the Legislature has once declared that a certain use is a public one, as it did in the law in question, the courts, as a general rule, will support it when not satisfied that a great wrong has been committed; and, when there is any doubt

as to the purposes, the legislative decision should always stand.

How the Supreme Court of the United States will decide this question remains to be seen. But taking into consideration the needs and necessities of the arid West, which resulted in change from the common law doctrine of waters to the doctrine

of appropriation which has already been sustained by that Court, and also the needs and necessities for the organization of the districts in question for the better development of the country at large, it seems to us that the Court will sustain the decisions already given by the Supreme Court of California.

SUGAR BEETS IN THE PECOS VALLEY.

By GEO. R. BUCKMAN.

THE sugar beet industry is rapidly growing in importance in the United States, as evidenced by the fact that the production has increased from 300 tons in 1887 to 21,825 tons in 1893. In spite of this great growth, we are still furnishing a relatively small proportion of the world's production of beet sugar, which in the latter year was 3,402,000 tons, about one-third of which was produced in Germany. In Europe there are fourteen hundred and fifty beet sugar factories, while in the United States there are but six. Since the United States produces only about twelve per cent of all the sugar it consumes, it would seem to require no argument to prove that there is room for a further very great expansion of the beet sugar industry in this country. Three-fifths of the world's production of sugar is derived from the sugar beet, and hence the facts relating to the progress in the culture of this root in the United States are of natural interest and importance.

It has long been known that the sugar beet attains its highest perfection in the so called arid region of the United States and particularly in its southern portions. The soil and climate of this region, supplemented by irrigation, conspire to produce beets high in sugar and purity and yielding heavily in tonnage per acre. Many well informed people believe that the beet sugar industry of the future will center in this region, and hence are watching developments in this quarter with great interest. I make no apology therefore in giving the following somewhat detailed account of results in sugar beet culture obtained during its present season in the Pecos valley, in southeastern New Mexico, to which the partial failure of this season's beet crop in Nebraska as well as in

parts of France and Germany lends a further timely interest.

It has been known for several years that beets yielding high percentages in sugar and purity could be grown in the Pecos valley; and as long ago as 1891 sample beets from the Valley were sent to the Agricultural Department at Washington, which analyzed remarkably high. But about two years ago The Pecos Company undertook itself by an extended series of experiments to determine accurately the capabilities of this section for beet culture. It engaged for this work Mr. E. M. Skeats, an agricultural chemist of Woolwich, England, who had had wide experience, not only in that country, but in South America and the United States. Under his directions several approved kinds of seed were distributed to the farmers in various portions of the Valley, the growth and cultivation watched, and analyses of the beets made at various stages of their growth. During the present season in particular these experiments have been carried on quite extensively, with results that are astonishing even to those who entertained the highest opinion of the Pecos valley as a sugar beet country. During the early days of November, analyses were made of beets grown in about twenty different places in the Valley. The results are remarkable. Beets were analyzed which ran as high as 21.10 per cent in sugar and 86.90 per cent purity, while the average of one entire field was 19.40 per cent sugar and 84.86 per cent purity. These high percentages were found in almost every part of the Valley, the only exceptions being where inferior seed had been used or where proper care and cultivation had been denied. None of the beets examined at that time had

attained full ripeness and hence it was expected that later they would yield even higher results. This has proven to be the case, as will be seen from the annexed table of analyses made about two weeks later. In this table analyses are given of twenty-five beets taken from ten feet of an average row. It will be seen that the average of these beets is 20.87 per cent sugar and 87 per cent purity. One beet yielded 23.75 per cent sugar, which is believed to be the highest saccharine percentage of which there is any authentic record. From the weight of these twenty-five beets it is estimated that the field will yield at the rate of 31 tons per acre.

Analyses of 25 Beets		Weight.	Sugar.	Purity.
Beets 1 to 7, each (average)...		5 oz.		
8,	"	9	21.60	88.00
9,	"	8	20.65	85.00
10,	"	8	19.00	83.00
11,	"	7	21.10	86.10
12,	"	8	19.00	83.10
13,	"	9	23.75	89.00
14,	"	8	23.20	89.80
15,	"	27	19.00	87.20
16,	"	17	19.40	87.80
17,	"	18	17.90	86.90
18,	"	42	18.60	87.10
19,	"	14	21.20	87.00
20,	"	14	22.60	87.70
21,	"	40	19.00	83.60
22,	"	14	22.10	87.10
23,	"	22	21.10	86.70
24,	"	27	20.20	86.00
25,	"	16	21.10	88.40
Average of 10 ft., 25 beets.		13.8	20.87	87.00

These results are sufficiently astonishing; but this is not all. The climatic conditions of the Pecos valley make it possible so to arrange the times of planting as to insure a continuous harvesting season from September till April. This is of immense importance in the practical manufacture of beet sugar, for the reason that it virtually doubles the average length of the sugar "campaign." This ripening of the beets throughout the entire winter seems almost incredible, but it is an undoubted fact nevertheless, and gives the Pecos valley a very marked advantage over every other region where beets are at present grown. In California the winter rains sometimes spoil the beets by causing a second growth, while in Nebraska and Canada as well as in France and Germany the crops must be taken from the ground before frost. Mr. Alfred Musy, the noted French beet sugar expert, who visited the Pecos valley last April, was astonished

at what he there found in relation to sugar beet culture, and with nothing more than this prolongation of the harvesting season. He did not hesitate to pronounce the Pecos valley as by far the most favorable region for sugar beet culture and sugar manufacture of which he had knowledge.

It is almost unnecessary to point out that such a misfortune as has just overtaken the Nebraska beet raisers can not occur in the Pecos valley. In the first place, a summer drought to retard the growth of the beet is there impossible; and in the next place there are no frosts to harm the beet during the last few weeks of its ripening, which is the period when it is adding most rapidly to its saccharine stores.

Possessing these numerous and great advantages, and with the enterprise that has from the beginning characterized its development, the Pecos valley can not fail to become a most important center of the beet sugar industry. The Pecos Company expects very soon to begin the manufacture of beet sugar on an extensive scale, and is maturing plans for the erection in season for next year's crop of a factory with a daily capacity of 500 tons of beets.

IRRIGATION BECOMING GENERAL.

IRRIGATION is spreading throughout the United States like a prairie fire in a windstorm. Agricultural classes have been studying the advantages of this sure method of farming for a long time, and the general drought of the past season has once more indicated that the richest and most fertile lands along the largest water courses are not safe without means of watering, for rain cannot be depended upon when most needed. Intelligence is received that for the coming season irrigation will be resorted to in various sections of Illinois, Indiana, Michigan, Ohio, Pennsylvania, New Jersey, New York, New Hampshire, Massachusetts and Maine. There was irrigation in several of the Southern States in 1895, and in 1896 every State in the whole Southern tier will farm more or less under the infallible plan. It is learned also that sections of Wisconsin, Iowa and Minnesota will fall in line, and that irrigation operations will be largely increased in Nebraska, South Dakota and North Dakota. In the former arid States and Territories of the West, great progress has been made in this safe mode of farming, but this article deals wholly with the rain belt. **THE IRRIGATION AGE** being the pioneer in irrigation journalism congratulates the country on the general adoption of the methods it has so long advocated.

That the wonderful success of the irrigated farm at Kankakee will give a great impetus to irrigation in Illinois there can be no doubt. Sooner or later this State and other States along the line of the great lakes will be watered by pipe lines from those great bodies of water, Illinois especially, penetrated as it is to be by the great Drainage Canal. Alarmists are saying that the withdrawal of 300,000 cubic feet of water per minute from Lake Michigan by the Drainage Canal will reduce the level of the lakes to such an extent as to interfere with navigation by the largest lake steamers. In a rain of six inches which recently fell over these lakes the quantity of water added to them was 1,079,640,176,000 cubic feet. It would take seven years for the Chicago Drainage

Canal to withdraw this quantity of water. This "drainage" canal is really a great ship canal, and by tapping it here and there crops will be aided to make cargoes for those ships.

But that is a matter of the future. For the immediate present, pumping plants will convey water from neighboring streams, as at Kankakee, and in this farmers can associate themselves together here and there and divide the expense. Reservoirs and lakes will be made in different sections, and various means will be employed in pumping the water. Two irrigations a season will prove sufficient in Illinois. Gas engines, oil engines and perhaps electricity will furnish the power, and it is likely that wind mills will cut a big figure. With a gasoline engine, a pump and a reservoir, small patches can be independent of any general irrigation companies, though it must be confessed that the latter have proved a great benefit in the far West, reclaiming thousands of acres of barren lands and transforming them into farms that produce not only one, but several crops a season.

During the recent meeting of the Illinois State Horticultural Society at Kankakee, one hundred of the members in attendance, with their wives, visited the irrigated farm of the Illinois Eastern Hospital for the Insane, on the invitation of Dr. Gopen, the superintendent, and the reported wonderful crops of the past season were investigated to their entire satisfaction. That many of these farmers will irrigate their orchards and gardens goes without the saying. Certain it is that a large number of them said they "didn't propose to wait on the rain any more." But corn, and everything that grows, can be irrigated, and, even in the most fertile regions of the rain belt, crops will be four-fold greater with irrigation than without it.

A bit of intelligence which is of importance to Illinois farm owners can be conveyed herewith. It is that a company has recently been incorporated at Springfield "to buy and sell farm lands in Illinois," which intends nothing less than the buy-

ing up of farms just now, when farmers, as is supposed, are discouraged and will sell cheap, put in irrigation plants and then sell them off at gilt-edged prices. The headquarters of this company are now in Chicago but the gentlemen have heretofore been operating in the same way further West. The Southern colonies, made up of farmers in Illinois and Indiana, will make their operations very profitable. There is much unfavorable comment in a quiet way, and it is charged that one of the men connected with this company is the prime mover in a certain Southern colony, and that, through other parties, he actually bought, cheaply, the farms of two men whom he personally induced to go South. But the point here is that this company, even in legitimate buying, see a chance for making big money by improving the farms through irrigation and selling them again. If this company can do this, the present owners can do the same, and thus bring up the value of their holdings.

The plan that many farmers will adopt is wind power, pumps and reservoirs or lakes. The bottoms and sides of these artificial lakes only require puddling. After this has been done the seepage will be no greater than the evaporation. A mill that will only pump enough water to irrigate one acre when applied direct from the pump, will irrigate from ten to twenty acres if the water is applied from the outlet in the reservoir. The advantage gained is found in the pushing power of the water when rapidly discharged from the reservoir at a rate of from two to three cubic feet a second, or at the same rate in gallons of from fifteen to twenty-two gallons a second. By this method but little water is lost. The land lying a quarter of a mile from the plant will receive almost as much as the tract directly adjoining the mill. When the reservoir is nearly empty the gate is closed, and it is filled by the same process and repeated on another portion of the farm.

Verily, the age of prayer for rain has been relegated to the dark past.

GOLD AND SILVER WEST

NEVER before in the history of the United States has there been such general and widespread interest and excitement in gold discoveries in the West. It extends all over the country, and the cablegrams indicate that it is felt all over the world. This furore is created by the new finds in Colorado alone—or the reported new finds in Colorado—and if a one hundredth part of what is claimed for Cripple Creek, West Creek, Leadville, etc., eventually pans out, it is all sufficient to startle the world. But the daily papers of the great Central and Eastern cities are not publishing all the news—or all the reports—from the West. For some reason or other they confine the sensation to Colorado mining stocks. The newspapers of every Western State and Territory are announcing new discoveries. The Nebraska press announces important new finds of gold and silver and, “a rival for Cripple Creek” is claimed for Fremont county, Wyoming. Utah announces a “world’s gold wonder in the Mercuer mines,” on “Herschel” ground; immense shipments of gold are announced from the De Lamar mines in Nevada, gold and opals in Idaho; a big strike of yellow metal in Bill Williams mountains in Arizona; new gold finds in California; a ten-foot solid vein of silver in the Old Dominion mines in Washington; a wonderfully rich gold strike at Monument Rock in the Santa Fé Canyon in New Mexico; a big silver mine in Texas, as well as gold reports from Alaska, and the discovery of an eighty-foot ledge of gold in Vancouver!

There are skeptics, notwithstanding all the excitement, and they are among the politicians and the investors. These people are prospecting about to learn the true inwardness of what they are pleased to term the “boom.” The politicians of the gold side look wise, and say “I told you so,” while the silver men hint that “all this talk of a flood of gold is part of some scheme to silence the silver clamor throughout the country and in Congress, it being taken for granted that the people, believing the reports in full, will conclude

that with the bringing out of all this gold, the value of gold and silver must become more equalized.” They say it seems to them “as if the boom was intended to be wholly gold, and to be for Colorado alone, but the other States and Territories became jealous and ‘filed their claims,’ the reports of silver from Washington, Nebraska and Texas coming from newspapers which saw through the conspiracy.”

Investors say that while they have no inclination at all to deny the truth of the reported discoveries in Colorado, they know that for a year past promoters have been preparing to spring the boom which has finally come.

The Chicago Stock Exchange has refused to list mining shares, but a Chicago Mining Exchange has been determined upon, with men of capital and reputation as its incorporators. Another institution, perhaps of greater importance, is also to be established, and such men as ex-Governor John M. Palmer suggest and father it. This latter is a rendezvous where miners and others who have valuable claims but possess no capital, may meet capitalists willing to advance funds for the purpose of developing such properties—after an investigation has been made.

Chicago is going into this Western mining development, not only in Colorado but in the other States and Territories, but, so far as the large investors are concerned, they will not go into it blindly. As to the Mining Exchange, the opening of the board is actually dreaded, for it is foreseen that excitement and speculation must run wild. Delegations of ladies and clergymen exerted their influence against the listing of mining shares on the Stock Exchange but they have failed in their crusade against the Mining Exchange.

No one doubts the existence of untold gold and other minerals in our Western States and Territories, and if these mining properties are thoroughly worked it will be proved that we have Kaffirs of our own. Whatever the truth or falsity of recent reports of great new finds, the “boom” is proving an advertisement that will at-

tract the capital necessary to bring the treasure to the surface. It will also attract poor men and adventurers by the thousands, however, and the prospect is that the advance army of goldseekers and workers will reach Colorado before the investors do, in which case there must be great hardships and suffering. It would only be just and humane, especially during the winter, for the State officers of Colorado to issue notices, for circulation throughout the country, describing the real situation and cautioning men who arrive on the grounds penniless of the ordeal that awaits them. Whatever Colorado is, it is no poor man's gold country.

A representative of THE IRRIGATION AGE visited Denver, Colorado Springs, the Cripple Creek region and Leadville soon after the present excitement began, and everywhere found the people holding the greatest faith in the gold production. Speculation was wild. At Colorado Springs three exchanges were crowded with frantic men all day. Sales of Cripple Creek in one week aggregated 11,852,457 shares. Streets were crowded and sidewalks blocked. The exchanges at Victor, Pueblo, and Denver were all making heavy sales.

Interviews with the managers of the various mines brought out the most extravagant statements. According to these gentlemen there was simply no limit to the gold. Ex-Gov. James B. Grant, of the Omaha and Grant Smelter, had just returned from a tour of inspection among the mining camps of the State. By the way, it was this gentleman's report, telegraphed broadcast, that heightened the excitement recently. Among other things he said: "Cripple Creek far surpasses the wildest anticipations of those who had the greatest hopes for the future of Leadville. Cripple Creek will produce more gold in the next twenty years than any camp ever known. Leadville has produced over \$100,000,000 in the last seventeen years. When they have been mining seventeen years at Cripple Creek it is safe to say that the camp will have produced over \$500,000,000. I have no hesitation in saying that the mines of Cripple Creek will soon excel the famous mines of South Africa."

The Denver, Salt Lake City and San Francisco newspapers were devoting a

great deal of space to the year's output of gold. They all agree that in another year, with the increase of mining operations, Colorado, Utah and California will yield more gold than all South Africa.

Colorado's gold production for the year 1895 was \$17,000,000. The number of men employed in the metalliferous mines of the State in 1893 was 22,876; number at present employed, 26,329. The silver districts show a decided falling off, while the gold districts show a heavy gain. It is claimed that the Cripple Creek, Leadville, Gilpin, Clear Creek and Boulder county districts have just commenced to demonstrate their great richness for the reason that thorough exploitation has not before been practiced except in a few isolated cases and, as a result, thousands of men will ultimately find employment where formerly only a few could be accommodated.

J. J. Crawford, California State Mineralogist, sends THE IRRIGATION AGE the official statement of the State Mining Bureau for last year, which shows that the value of the mineral product, including the metallic and non-metallic, hydrocarbons and gases, and structural materials, was \$20,203,294. Gold leads all the rest, with a total of \$13,923,281. Calveras county produced most of the precious metal, with an output of \$2,119,365. Petroleum, which is a developing branch, comes second in point of wealth. The State's product of this was valued at \$1,064,523. Silver amounted to \$207,331 and quicksilver to \$934,000.

The governor of Arizona says that Territory produced the past year \$10,000,000 in gold, against \$4,000,000 in 1894.

Alaska's gold output for 1895 is estimated by G. H. Swinehart, editor of the Alaska Mining Record, of Juneau, to be \$3,000,000. Of this amount \$800,000 has been obtained from placer mining, chiefly along the Yukon river. Mr. Swinehart says there are fifteen mills, with a total capacity of 500 stamps in operation.

America is holding her own as the leading gold nation. Last year we led South Africa. The latter mined \$39,555,836, while the United States mined \$39,775,000. For 1896 the prospects are great, and Alaska is beginning to tell.

THE DIVERSIFIED FARM

In diversified farming by irrigation lies the salvation of agriculture

HOW AND WHEN TO IRRIGATE.

BY F. C. BARKER, NEW MEXICO.

HOW and when to irrigate will depend so entirely upon soil, climate, weather, crops and many other varying circumstances, that no hard and fast lines can be laid down.

Take for instance the first question of whether we shall irrigate by small furrows, as in California, or on the moat by the flooding system. I maintain that it all depends upon whether the soil is porous and soaks laterally or whether the soil is the reverse, as it is where I live. Furthermore, the furrow system will suit certain crops while it will not do for others. The best system can only be found out by experience in each locality. Then, as regards the frequency with which crops should be irrigated. I venture to say that no one can fix this by any given number of days. Different crops require different treatment, and even the same crop will need more or less water according to the conditions of soil, weather and climate. The only rule one can lay down is that no crop needs water so long as the soil about the small roots nearest the surface is wet enough to roll up into a ball; but the moment any of these small roots are in dry earth the plant or tree is sure to suffer.

Serious harm has been done to many orchards whose owners read in books or papers that in California they did not irrigate during winter, and accordingly applied the rule to land which received little or no rainfall in the winter, quite forgetting that the reason why they do not irrigate during winter in California is that that is their rainy season.

I have sometimes been amused by reading calculations of how many inches of water are needed for irrigation. Some writers have made a regular formula, as though it were an engineering problem, and, having arrived at the exact number of inches required by a crop, deduct the

natural rainfall and think they have the whole question settled. Now, in the first place, the rain may come when it is not needed, and again it often falls in such small quantities at a time that it rapidly evaporates and thus does very little toward assisting irrigation.

No one can farm successfully with irrigation any more than without it who does not understand plant life sufficiently well to know when water is needed by a tree or plant. It requires experience like every other branch of farming. The inexperienced man may make a failure by not giving enough water to keep the roots moist right down to the bottom, or he may, and frequently does fail through giving so much water that the soil becomes waterlogged and deprived of air; but a still more frequent cause of failure is the omission to cultivate the surface of the soil after each irrigation. It is only by actual experience gained in each locality that the farmer can learn how and when to irrigate.

Fertilizers for Potatoes.—Like all other farm products, potatoes yield in proportion to the soil in which they are grown. To have a good crop, the land must be reasonably good, and to maintain its fertility the soil must be fed by some means.

If barnyard manure is used, it should not be coarse, or it will do more damage than good, in burning the vines. And, again, it must not be hauled out in the spring and only partially plowed under. The manure should be rotted sufficiently to be thoroughly incorporated in the soil, and be hauled out in the winter or early spring and plowed under, deep.

Potash and phosphoric acid are the principal elements of plant growth needed, and in many cases these can be supplied to a better advantage by purchasing and using commercial fertilizers than in any other way; because they contain a good percent of potash. Wood ashes can often

be used to a good advantage in growing this crop.

Bone dust is a good fertilizer for this crop, but it is usually not as readily soluble as is what is generally considered a good grade of complete fertilizers, but the bone meal is usually more lasting in its effects.

Let the material used be what it may, it is very essential to have it thoroughly incorporated with the soil, while with care very good results can be obtained by applying in the hill. The best growth and yield can be secured by applying broadcast.

This, of course, requires a larger quantity, but it is less work to apply, while more benefit can be derived. When animal manure is used, a good plan is to apply after plowing, and the work of properly preparing for the seed will work sufficiently in with the soil, but with ashes or commercial fertilizers, if applied broadcast, a good plan is to partly work the soil into a proper tilth, then scatter the fertilizer broadcast, and one or two good harrowings will work sufficiently into the soil. In neither case should the fertilizer come in direct contact with the seed.

Something for Market.—A farmer, who is always complaining about hard times, poor crops and the poor markets for farm products, went to a neighbor farmer to borrow money with which to pay his taxes.

On entering the door he noticed an egg box well rounded up with fresh eggs ready for market. Just inside the pantry door was a large pailful of butter prepared for shipment. While talking about the good price being paid for potatoes the money lender remarked that he had several hundred bushels of good potatoes for sale. He also had several tons of hay to dispose of at the good price then being paid. He always kept a small bunch of sheep, and as he did not want to increase his flock the increase of last season must be sold. This numbered forty head, which were fat and ready for the market at the highest price. The others would soon yield a fine clip of wool. The granary contained a great deal more wheat, corn and oats than that necessary for seed, bread and feed for the animals for another harvest. In an old-fashioned smokehouse was hanging a lot of pork which could not

be consumed by the family during the season, and of course a portion of it was for sale. The moneyless farmer stated his mission, was furnished with the money he desired and at once started for home. He wore a downcast expression, and his gait indicated that he was thinking. What his thoughts were we leave the readers of the Age to conjecture.

Profits of Gardens.—A half-acre fruit and vegetable garden well cared for as a market is worth from \$100 to \$200 to any intelligent farmer's family in this State, says M. A. Thayer, president of the Wisconsin State Horticultural Society. A good garden, he says, will often banish the doctor from your house and the sheriff from your door. It will make the boys and girls love the farm when everything else fails. Last season he harvested 2,500 bushels of strawberries. The cost for cultivating, picking and marketing was five cents per quart, and the berries were sold at an average of eight and three-fourths cents per quart. The farmers who purchased the berries paid two cents for raising them, one cent for picking, one cent for crating, one cent for delivering, and the balance amounted to 375 per cent above actual first cost, counting the retail price at ten cents per quart.

Can farmers afford to pay such profits when they can just as well be reaping the harvest themselves? The way to prevent what some farmers may call wholesale robbery is to grow the berries at home. The cost of plants is but small and the work required to put out a half acre of small fruits is but a trifle when the profits are considered. Other small fruits and vegetables are equally as profitable and as much desirable.

Dairymen Must Organize.—In the past, dairy farmers have been the victims of sharks on all sides. They are awakening to the fact, however, that there is a way of protecting themselves and dairy interests generally by organization, and these organizations are being entered into freely. The victory over oleomargarine or "hog butter," should be a great encouragement to these farmers to go further and root out the numerous other evils, among them bogus cheese. By organization, prices can be regulated in a

measure and expenses can be reduced, and the various sharks that beset dairy interests can be driven off.

As to the cost of running a dairy in a first-class way, the following official figures will be of great importance. They show the receipts, expenditures and profits of the Ohio State University dairy for a year:

Pounds of milk produced.....	160,554.000
Receipts for milk.....	\$3,842.75
Cost of food.....	983.76
Cost of labor.....	1,595.44
Total expenditures.....	2,579.20
Net gain.....	\$1,333.55

There was an average of about twenty-six cows actually in milk in the dairy during the year. As cows are bought and sold, not the same twenty-six cows were in the herd throughout the year. There are generally, also, three or four dry cows in the herd. From the summary it will be seen that for the number of cows actually in milk 6,175 pounds of milk were given per cow. The cost of food per cow was \$37.83, and the cost for labor was \$61.36, making the total expense per cow in milk, nearly \$100. The labor, however, included a considerable amount of experimental work and also the labor of taking care of dry cows, heifers, calves and bulls. It also includes the cost of retailing the milk. The cost for food only relates to the cows in milk. Assuming 8.6 pounds per gallon of milk, the cost of food per gallon of milk is 5.2 cents, the cost for labor per gallon of milk 8.5 cents, while the average price received for milk on this basis was 20.5 cents. It will be seen that the average cost of a gallon of milk retailed to consumers was 13.7 cents. The real cost, however, is somewhat greater than this, because more than 8.6 pounds are required for a gallon of milk when peddled to the consumers. It is worthy of notice that the work was all done by students, for which, it will be seen, they received \$1,595.44. The gross income from each cow actually in milk was \$147.80, the expense \$99.19, leaving a net income per cow of \$48.61, or, for a herd of twenty-six cows, a net gain of \$1,333.55.

Cherry Culture.—In planting cherries avoid all conditions that are calculated to force a strong growth of wood and select sites that will tend to retard

development in the early spring. Fruit buds if too far advanced are liable to be killed by the late frosts when the tree itself is quite hard. To prevent the bark bursting, as is frequently the case in the West, the tree should be trained to branch near the ground. The low branches seem to be the better method for growing cherries in all the Western country. In Russia, where the cherry is successfully grown, the bush form has proven the most convenient and best producer. The trees should be planted on rather light, well-drained soil, on a northern slope if possible. Water should be used sparingly and the soil cultivated sufficient to induce a moderate and definite annual growth.

Do Your Hens Lay?—Yes, I feed my forty-five pullets three mornings in the week, six quarts finely chopped hay, timothy and clover mixed, six quarts boiling water and two quarts each of bran and middlings; two mornings, four quarts of small potatoes and turnips boiled, mashed and mixed with two quarts each of bran and middlings, and two mornings, the same amount of bran and middlings mixed with scalding hot milk. At noon I throw a basketful or two of chaff from the barn floor to them. At night I give three pints of wheat or, when very cold, two quarts of corn heated in the oven. Sometimes I substitute a quart of oil meal for the two quarts of middlings in the morning. In addition the hens have all the bones from our beef and pork, oyster shells and scraps from the lard and tallow. The latter, chopped fine, are fed twice a week, three pints at a time in the morning.

The Irrigation Farmer.—Irrigated farms have a tendency to induce their owners to cultivate crops that will pay the largest profits, and the irrigation farmer is, in a vast majority of cases, a man of high intelligence, who studies to make his land as profitable as possible. He has broken loose from the traditions of his forefathers because he is surrounded by different conditions. He has learned what it means to control the water supply of his land, and he seeks to take advantage of this tremendous lever to cultivate his acres. Farming, with him, is a science, in which he has learned that the conditions which tend toward success are greatly in his favor, if intelligently applied,

and he uses this intelligence to produce the best results. Water is the predominating element in farming in the arid region, and its value will never be less than at present, while its average cost is likely to diminish through the use of improved methods for its conservation and distribution.

The Kansas Corn Crop.—Secretary Coburn of the Kansas Board of Agriculture has just issued his final crop report for the year. The item of foremost interest is the yield of corn. The secretary says: "The yield for this year, with one exception, is greater than in any previous year in the State's history and ranks Kansas one of the four banner corn States of the world. The total product is 201,457,396 bushels, an average yield on the entire area planted (8,394,871 acres) of twenty-four bushels per acre. The average price of corn for the year is given as 23 cents per bushel and the price at which it is being sold or contracted (delivered) in the principal corn counties ranges from 16 to 21 cents and averages 18 cents. Thirty-three per cent of the crop is reported as likely to be disposed of at the latter average by the close of the year."

The Broom Corn Crop shows a very large increase in acreage over '94 in Kansas, amounting to more than 50 per cent, while in Illinois a small decrease is apparent. The total acreage of the country is estimated at 200,100 acres, or more than double the area cultivated in '89, as returned by the census. This, taken in conjunction with the average yield per acre, as computed by Orange Judd Farmer, points to a '95 crop of 57,000 tons, compared with 19,300 tons in '89.

Low Priced Potatoes.—Not in years have potatoes sold as low in Chicago, South Water street merchants complaining of excessive offerings and a difficulty in clearing up accumulations. In Wisconsin large quantities are being stored in pits, subject to frost damage, and Minnesota and the Dakotas are equally loud in their complaints of a lack of market, especially if some distance from railway. Chicago receipts have been as great as 100 cars per day and recently as many as 275 cars, or 130,000 bushels, were on track awaiting

sale, against an average daily consumption of 30 cars, leaving the surplus for shipment.

That New Insecticide "raupen-leim," or German insect lime, is proving wonderfully useful and effective in combating a wide variety of insect pests. The main objection to it is the cost, but this has been met by an American imitation called "dendrolene" that is much cheaper and apparently quite as effective. The New Jersey experiment station deserves the credit of introducing and testing these new compounds.

Cow Peas.—The fertility of a large peach orchard in Georgia is kept up by sowing cow peas between the rows, and letting large numbers of hogs harvest them in November and December. Peas are a much better feed for young hogs than corn. How difficult it is for us to get away from the belief that corn is the only crop we can grow with success and profit for the hogs!

Kaffir Corn.—The farmers of Oklahoma have been experimenting with the new Kaffir corn, and they are now ready to declare that it will bring more money to the farmers of the United States than all of the famous gold mines of the Kaffir country from which it comes. Nebraska, Kansas and other States are also growing it.

Winter Oats.—Letters from experiment stations throughout the central West show that winter oats have been tried in but a few localities north of the Ohio; that practically no systematic tests have been made of them in all that region, and that they have been most successful in the extreme Southern portions.

Beans not Seeds.—The question was taken all the way up to the United States Supreme Court, and that body has decided that beans are not seeds but vegetables.

Pumpkins and Turnips. fed with meal, will make a better appetite and guarantee those important streaks of lean and fat which command the best prices.

Ducks for Profit.—Only in exceptional cases should any more mature ducks be kept than are needed to produce the eggs necessary for hatching. Two good drakes and ten hens, if kept in a good, thrifty condition, will lay a sufficient number of eggs to hatch out a thousand young ducks.

A Necessity.—Another year with its usual dry spell convinces us more than ever that something must be done, something raised on the farm that can tide domestic animals over these periodic droughts; and sorghum comes as near answering the purpose as any crop we know of.

Overcrowding, wrong ventilation and filthiness of quarters are three evils that will be responsible for many cases of roup, diarrhoea or cholera among fowls during the winter.

Give Charcoal.—Place a box of coarsely pulverized charcoal where hens can help themselves when they want it. They will eat a large quantity in a season, and it has a cleansing effect on the system and prevents many disorders of digestion.

Holding Their Corn.—Many farmers throughout the whole country, who can afford to do so, are holding their corn for a better demand and better prices.

The Wool Clip of the United States for the year 1895 is estimated as follows: The total product, washed and unwashed, is put at 294,296,726 pounds, as compared with 225,210,602 pounds for the year previous. Reduced to a scoured basis the total clip for this country was 125,718,690 pounds.

Grain Weighing.—A movement is on foot to have the system of weighing grain reorganized in such a way that the seller will not be defrauded of a portion of his grain by carelessness, or worse, among those who weigh it when received at Chicago.

Warm Water—Hanford Reynolds, in Hoard's Dairyman, insists that in the winter time cattle, horses and other stock should be given warm water. He urges

that the ice water not only causes suffering but prevents fattening.

Don't let the manures leech out and rot out, in the heaps around the stables. Haul to the fields and meadows as fast as they accumulate and you will be all right.

If Worms are eating the grape leaves a solution of white hellebore will stop them.

Simple.—An Iowa farmer claims to have saved his hogs from cholera by feeding them pumpkins. He says the seeds did the work.

Electrical Incubators are the latest idea in artificial hatching.

INSPIRATION.

[J. Laidlaw on the situation in the central Western States.]

My fields of grain I drove across
To figure out my gain or loss—
But all around it seemed I heard,
Said to my soul this curious word—
"Irrigate."

I trod my dusty corn fields thro'
And picked the ears so small and few,
But every nubbin I let fly
Seemed in my dust-filled ear to cry—
Irrigate!

My half starved bairns so thinly clad,
My worn out wife so pale and sad,
My ragged clothes—my courage gone,—
My shabby home, all seemed to moan
Irrigate!

And debts and duns were crowding thick,
And shades of sheriffs made me sick,
And merchants watched me keen and close,
While from their lips this word arose—
Irrigate!

A tented wagon moving South,
Some poor starved victim of a drouth,
Or hunted thief—me come to this!—
I hear my wagon creak and hiss—
Irrigate!

I raised my soul in prayer to Him
Who feedeth serf and seraphim,
To aid and bless—across the night
Flashed out the burning word of light—
Irrigate!

Down in the sunless caverns hid,
My riches but await Thy bid—
Go make the watery treasures come
To glad thy fields and bless thy home—
Irrigate!

AGRICULTURE AND COMMERCE

Senator Stewart, of Nevada, woke the Senate up the other day. He said the great depreciation of silver gave to the cheap labor of Asia a tremendous advantage in competing with the domestic products of the American market. Japan, in particular, he said, was profiting by this difference of 50 per cent between our money and that of Japan, and Japanese merchants were to-day underselling our home producers in many lines of goods.

The latest statement of the visible supply of grain, as compiled by the New York Produce Exchange, is as follows: Wheat, 66,835,000 bushels; increase, 3,049,000 bushels. Corn, 5,227,000 bushels; increase, 20,000. Oats, 6,134,000 bushels; increase, 123,000 bushels. Rye, 1,555,000 bushels; increase, 104,000 bushels. Barley, 4,475,000 bushels; decrease, 279,000 bushels.

A cable between the United States and Hawaii has been incorporated, and it is predicted that at no distant day the line will be extended to Australia and China.

According to the last census report more than \$100,000,000 are invested in "truck farming," mostly early vegetable production, in the United States, and the annual yield from the 534,440 acres of land so occupied is \$76,517,155 net after paying freights and commissions, or over \$143 per acre net cash returns.

Thomas G. Merrill, of Montana, chairman of the Finance Committee of the National Bimetallic Union, says: "The recommendation of the President to retire greenbacks, if carried out, would be disastrous to the silver interest. The retiring of the national currency, issued under the Sherman act, which has been the means used for the recent heavy withdrawals of gold from the Treasury, would mean that the bullion in the Treasury would be thrown upon the market, causing a decided decline in the price of silver."

In attendance on the Illinois State Grange at Springfield were 165 delegates, while sixty-five delegates were in attend-

ance on the annual convention of the Pomona Grange, an organization devoted to women. During the year twenty-five new granges were organized, with 300 members, making 1,700 Granges in the State, with a total membership of 8,000.

The movement to have the Michigan State Grange indorse ex-Governor Luce for president of the Michigan Agricultural College was abandoned, but the Grange spoke out as to the manner of man who should occupy that position, and recommended an amendment to the law requiring that members of the board in charge of the college be elected by the people instead of appointed by the governor as now.

Officers elected at the meeting of the Indiana Grange were as follows: Master, Aaron Jones, South Bend; overseer, P. B. Ewan, Hayden; lecturer, F. J. S. Robinson, Cloverdale; steward, G. W. Sawdon, Anrora; assistant steward, G. W. Laird, Columbia City; chaplain, Milton Trusler, Connersville; treasurer, J. W. Holmes, Cortland; secretary, T. B. Frazier, Frankfort; gatekeeper, O. M. Curry, Terre Haute.

The Illinois Patrons' Aid Society elected the following officers: President, D. O. Trotter, Jersey county; vice-president, Mrs. M. M. Baker, McLean county; secretary, H. K. Smith, Putnam county; treasurer, Mrs. R. Newman, Coles county; board of managers, C. W. Gree, Marion county; J. P. Smith, St. Clair county; Fred Helms, St. Clair county.

Progressive members of the Chicago Board of Trade are holding meetings and considering a plan for a change of methods in trading. The proposition is to compel the elevators to do business on a cash basis. It was shown at a recent meeting that \$20,000,000 is annually paid for carrying grain that does not exist.

Farmers seldom fail, but it is well enough for them to be posted. If a farmer is mortgaged and it finally comes

to the worst, he should make an assignment, and not give up the farm to the mortgagee. By this plan he may save something to himself after the debt has been paid, while in the other case he loses the farm and gets nothing.

That famous steer belonging to Hetfield, of Watseka, Ill., which weighed 4,000 pounds, has been sent to the Chicago stockyards. The animal has been exhibited at many fairs during the past few years and is said to be the largest steer ever raised in Illinois.

Standard silver dollars actually in circulation Nov. 1 were 58,354,092, out of a total of all kinds of money of \$1,598,859,-316. Gold coin 475,181,593, subsidiary silver 63,832,759, the remainder being paper money. The per capita circulation is placed at 22.72.

In eleven months silver shipments from the Pacific coast to Hong Kong and other Chinese and Japanese markets were over \$16,500,000 against \$12,000,000 in 1894. This accounts for the small shipments of silver from London to the Eastern markets.

Total imports of merchandise during November, \$63,343,759, of which \$32,539,-725 was free of duty; for 1894, \$50,567,-482, of which \$23,934,666 was free of duty. During the previous eleven months the imports amounted to \$730,416,217, against \$614,177,510 for 1894.

Total amount of domestic exports during November, \$85,151,267, against \$78,-887,384 for November, 1894; for the previous eleven months, \$716,664,832 against \$723,648,063 in 1894.

The National Live Stock Exchange elected the following officers: President, William H. Thompson, Chicago; treasurer, L. B. Doud, Chicago; secretary, Charles W. Baker, Chicago; vice-presidents, D. McN. Palmer, St. Louis; W. B. Stickney, East St. Louis; J. G. Martin, Omaha; J. H. Nason, Sioux City; L. B. Doud, Chicago; John Payne, Kansas City; W. E. Skinner, Fort Worth, Texas. Executive Committee: W. H. Hines, Charles Jones, St. Louis; E. B. Overstreet, C. M. Keys, East St. Louis; J. A. Hake, D. L. Campbell, Omaha; H. D. Pierce, W. M. Ward, Sioux City; C. A. Mallory, Irus Coy, Chicago; E. G. Bridgeford, J. C. McCoy, Kansas City; G. W. Simpson, C. W. Simpson, Fort Worth.

The board of directors of the American Shorthorn Breeders' Association are: W. E. Boyden, Delhi Mills, Mich.; H. F. Brown, Minneapolis, Minn.; Emory Cobb, Kankakee, Ill.; J. B. Dinsmore, Sutton, Neb.; W. A. Harris, Linwood, Kan.; A. H. Jones, Delaware, Ohio; C. E. Leonard, Boonville, Mo.; S. F. Lorhridge, Greencastle, Ind.; John McHugh, Cresco, Iowa; J. Frank Prather, Williamsville, Ill.; Abram Renick, Sycamore, Ky.

Representatives from every county in the north half of the State were present at the recent meeting of the North Central Illinois Poultry Association at Princeton.

The Farmers' Institute for Northeastern Indiana has just closed a big meeting at Butler. Col. J. H. Brigham, Prof. W. C. Latta and many other leading lights were present.

The very latest exhibition scheme, suggested by the various exhibition trains, contemplates the circling of the earth with a fleet of splendid expedition ships to show the world what America can make and grow. The scheme calls for the construction of one or more expedition ships, where space can be rented for the display of the products of both the soil and factory upon the same principle as is done in expositions, except that in the proposed floating exposition only American products shall be exhibited.

Reports from Topeka say that several weeks ago a carload of hogs were shipped into Harper county, Kansas, from Nebraska. They were diseased, and since then over 1,000 head of hogs have died with cholera. The epidemic has spread into three counties.

The National Grange elected the following officers for the ensuing term of two years: Master, J. H. Brigham, Ohio; overseer, Aaron Jones, Indiana; lecturer, Alpha Messer, Vermont; steward, J. L. Cox, New Jersey; assistant steward, A. J. Newcomb, Colorado; treasurer, Mrs. E. S. McDowell, New York; secretary, John Trimble, Washington, D. C.; gatekeeper, W. E. Harbaugh, Missouri; chaplain, O. N. Hale, New York; Pomona, Mrs. Sarah G. Baird, Minnesota; Ceres, Mrs. Lucy G. Smith, Ohio; Flora, Mrs. L. E. A. Wiggin, Maine; lady assistant steward, Mrs. S. G. Knott, West Virginia. Executive Committee, J. J. Woodman, Michigan; N. J. Batchelder, New Hampshire.

Wool importers have just opened a great Wool Exchange in New York. It is an eleven story fire-proof building and cost \$1,000,000. This enterprise alone indicates what the free traders in wool expected. But the best laid plans, etc.

Transcontinental freight rates will be advanced by the Panama Railroad Company and all of the overland roads at a meeting soon to be called in Chicago or New York. The advance, it is said, will be the result of the new contract recently made by the Panama road and the Pacific Mail Steamship Company, by which the former is given the right to fix rates on west bound shipments.

George L. Bowen, president of the Textile Manufacturers' Association of the North and West, has called a meeting of the association in Chicago on the 14th inst. for the purpose of deciding on the association's position in recommending legislation calculated to relieve the financial stringency. The association numbers 1,200 manufacturers of cotton and woolen goods, operating 2,000,000 spindles and 1,000 sets of wool cards.

Patriotic decorations and patriotic speeches were the order at the American commercial banquet given at Delmonico's, New York. It was the centennial celebration of the Jay commercial treaty with Great Britain as well as the inauguration of the annual observance of "Commercial Day" by all organized commercial bodies.

A blanket mortgage for \$175,000,000 given by the New York, Lake Erie & Western Railroad to the Farmer's Loan and Trust Company of New York has just been filed.

Some Illinois postmasters just confirmed are: A. M. Davis, at Rossville; C. L. Cornean, at Forrest; W. W. Twist, at Tolpea; E. K. Mercer, at Princeton; D. C. Marsh, at East St. Louis; D. F. King, at Roodhouse; F. Friede, at Mount Olive; R. Forester, at Murphysboro; J. A. Dufield, Woodstock; J. Clark, Morrison; N. Flack, Milford; H. S. Coffeen, Homer; M. Maloney, Dixon; E. S. Clemens, Chester; J. D. Martin, Carmi; W. B. Fleming, Bement.

An assignment has been made in the County court in Chicago, by the Illinois Live Stock insurance company. Homer S. Galpin is named as assignee.

But recently Manitoba and the Cana-

dian Northwest Territory were the home of men little better than savages; and yet, in the past year, nearly as much wheat has been raised in that region as in the whole of the United Kingdom.

H. C. Wheeler, the big Sac county (Iowa) farmer who ran for governor four years ago and who changed from horse-breeding to dairying, has got his milking machine in operation, with which 100 cows are milked in one hour. A gas pipe passes along the stalls to which is attached a rubber tube and cup, which is clasped over the teats of the cow. The milk is drawn by suction or pressure furnished by machinery. The milk is carried to a large reservoir. But two men are required to do the milking. The cows seem to enjoy the process better than when the hands are used.

Postmasters just confirmed in Kansas are as follows: A. G. Patrick, at Oskaloosa; J. L. Mattingly, at Sedan; G. W. H. Lucas, Cherokee; Robert Kennedy, Pleasanton; J. C. Haskett, Baxter Springs; L. B. Davidson, at Girard; C. P. Baldwin, at Belleville.

A correspondent writing from Hillsboro, New Mexico, says he has what can be called a true hybrid—a cross between wheat and winter barley. It has a tendency to take the two-rowed barley head, but is very large and plump.

Government reports just made show that the exports of gold during November aggregated \$14,066,460, an excess of exports over imports of \$13,473,876, against an excess of \$1,507,388 in imports over exports for the same month in 1894. The exports of gold during eleven months in 1895 amounted to \$89,130,639, as compared with \$92,017,535 for the same months, in 1894.

The exports of silver coin and bullion during November amounted to \$5,418,091, and the imports \$1,017,503. The exports during November, 1894, were \$3,608,778, and the imports \$727,050.

The new Kaffir corn, grown in Oklahoma and Kansas, is pronounced wonderful. A Medicine Lodge (Kan.) miller experimented and finally produced Kaffir flour which will create a revolution in the world's breadstuffs. Bread made from it is sweet to the taste, highly nutritious and satisfactory to the eye, being about the color of the best graham bread.

THE FUTURE OF PRICES

THERE is general faith in the future of prices for corn and wheat. Bankers and syndicates are advancing means to farmers and stock raisers in the West so that they may be enabled to hold their stock for a time. Something agriculturists should know is the fact that an Eastern company is buying up corn in the West at the cheap prices to hold it for a rise.

Prices of beef cattle at the Union Stock Yards in Chicago have been weak and lower all around. Country holders, just now, seem to be rushing their stock in. In a single week the receipts were 76,000 head. Of hogs, the receipts the same week were 240,000, an increase of nearly 50,000 over the preceding week, prices ranging at \$3.50 to \$3.65 for all weights. As to the future of prices for cattle and hogs no good prediction can be made. The bulls claimed that there must be an advance after the holidays, while the bears "explained" why prices should rule lower. A steady market for sheep is likely during the winter.

Receipts of cattle in Chicago for the year up to Dec. 1, show a decrease from 1894 of 395,352 head. Notwithstanding this great shortage and the alleged combine of the "Big Four," prices went down to the present low figures. Receipts of hogs for the eleven months show an increase of 356,171 head. Receipts of sheep show an increase of 333,967. The increase of horses was 17,511 head.

The trolley and bicycle have certainly ruined the market value of their predecessors. An auction sale of horses from the Chino ranch at San Bernardino developed the fact that there is less demand than ever for such animals. The prices ranged from \$2.00 to \$17.50 and some of the horses sold were ones which a few years ago would have been in demand at \$100. Richard Gird has made the raising of horses one of the features of his ranch, but since there is no longer any profit in the business he determined to dispose of them, which accounts for the

auction. One splendid looking gray mare, with good style, went for \$8.50. Another pretty bay was knocked off for \$2.00, and so the prices went throughout the sale. A team of beautifully matched bays, with splendid black mane and tails, finally went for \$35.00, \$17.50 each. This was the best price obtained for any of the horses sold.

Of wool Dunn's latest report says: "The market has not advanced with London sales as was expected, and 5,536,100 pounds have been sold; 2,303,700 pounds foreign against 5,479,300 in the same week of 1891, of which 1,413,500 were foreign. The slow market for goods hinders dealings. Manufacturers have had a profitable season though trade is dull now."

Of the future of the flour market at Minneapolis, a reliable correspondent says: "Lake shipments have closed for the season, but the prospect is that the production will be maintained at a comparatively large figure during the winter. If reports coming in to local millers are true, trade is getting back to the demoralized shape that it was in before the advent of the new crop. The latest net quotations at the Minneapolis mills for car or round lots were:

	Per 196 lbs.	
	Present.	Year ago.
First patent, in wood...	\$2.85@3.80	\$3.15@3.50
Second patent, in wood..	2.65@2.85	2.90@3.05
Fancy clear, in wood...	2.15@2.45	2.15@2.80
Second clear, in bags..	1.60@1.70	—@—
Low-grade, in bags....	1.40@1.50	1.80@1.90
Red-dog, in bags.....	1.05@1.10	1.40@1.50

Local prices at Minneapolis on flour to grocers and retailers are, per 196 lbs. in sacks, \$3.30 for patent and \$3.20 for straight. Most grocers, in selling to consumers, add 50c per bbl. as their profit.

The output of flour at three mill points—Minneapolis, Superior-Duluth and Milwaukee—for the week ending Dec. 14 was twice as much as during the same week in 1894, or 360,635 barrels against 151,925 barrels.

THE PROGRESS OF WESTERN AMERICA

A PROMINENT CALIFORNIA ENGINEER.

WE herewith present to our readers a likeness of F. C. Finkle, C. E., who is the author of the article on "Water Supplies for Irrigation," the publication of which is begun in the present issue of *THE AGZ*. Mr. Finkle intends at some time in the near future to publish an exhaustive work on irrigation engineering, of which the present chapter on "Water Supply for Irrigation" will form a part substantially as it is published herein. *THE AGZ* has made arrangements to publish this one chapter in advance of the issuing of the book, which will contain eight or nine other chapters equally as complete and interesting for students of irrigation engineering and irrigation engineers as well as for practical irriga-

tors, but dealing with other topics of irrigation engineering, so that the whole subject will be fully covered in the book. From a perusal of this chapter it will be readily seen that the book to be published by Mr. Finkle will be wholly different from any book heretofore published on the subject. It will contain all the scientific matter applicable to the subject, all results of experiments, all rules and formulas applicable to irrigation engineering and a full discussion of the best practice in all the branches of the science, including a large amount of matter heretofore never published, or entirely original. Such a work is now in urgent demand and the publication of Mr. Finkle's book will be eagerly looked forward to by all interested in irrigation and irrigation engineering.

In this connection it is proper to give a short sketch of the accomplished hydraulic engineer, F. C. Finkle, who is the author of this work. Mr. Finkle is undoubtedly one of the most highly-educated and able men in the engineering profession at the present time. He is a very fine mathematician as well as a man thoroughly well versed in the classics, and modern languages. His knowledge, therefore, does not alone cover the subjects connected with his profession, but includes a thorough knowledge of Latin and Greek as well as a reading, writing and speaking knowledge of English, French, German, Spanish, Italian, Danish, Swedish and Norwegian, in all eight modern languages. This knowledge has aided him very materially in collecting the material for his book.

Mr. Finkle first prepared for his profession by taking a special course in the University of Wisconsin, after which he completed his knowledge by studying and traveling abroad for over two years. Since that time he has been located at San Bernardino, Southern California, one of the most important irrigated sections in the world, where he has been actively engaged in the practice of irrigation engineering. His practice has extended all

F. C. FINKLE,

Mem. Am. Soc. Irr. Engs. of San Bernardino, California.

over Southern California as well as some parts of Mexico and the Western States and Territories. Some of the important works of which Mr. Finkle has had exclusive charge as Chief Engineer are the Jurnpa Canal, Water Works of the City of San Bernardino, the irrigation systems of the Grapeland Irrigation District, and of the East Riverside Irrigation District, and the Vivienda Pipe Line, all of which are in Southern California. In these and other enterprises he has had a great deal to do with developing water supplies, designing works and superintending construction and surveys. During all the time he has practiced his profession he has been engaged in doing consulting and expert work for companies for which he has not been chief engineer and has experted some of the most important litigated cases and water properties in the west.

He has also contributed at various times to irrigation literature, although his practice has prevented him from doing as much of this as he would like to have done.

Mr. Finkle desires any one having criticisms on the chapter on "Water Supplies, etc.," to correspond with him, and due acknowledgment will be given in the book, when published, to all who may discover errors in the manuscript or

who make valuable suggestions. The manuscript never having been reread and rechecked, as yet some slight errors may be found to exist, which, if there are any, should be corrected before it is published in book form.

GEN. J. H. McLEARY, OF TEXAS.
President of the State Irrigation Association.

STATE CONVENTION AT SAN ANTONIO, TEXAS.

THE general interest and progress in irrigation in Texas was well indicated by the representative State meeting held at San Antonio. It was the second annual convention of the Texas State Irrigation Association, and the deliberations occupied two days, with night sessions. Prominent gentlemen in attendance were J. H. McLeary, San Antonio; T. M. Paschal, San Antonio; P. J. MacMahon, Laredo; W. B. Parish, Seguin; A. Sinclair, G. Q. A. Rose, San Antonio; F. Vandervoort, Carrizo Springs; W. S. Marshall, Fort Worth; W. D. Kingsbury, Boerne; Prof. A. E. Blount, Las Cruces, New Mexico; J. M. Mathews, W. W. King, A. F. Dignowity, N. T. Ayres, J.

F. H. NEWELL,
Of the Geological Survey, Washington, D. C.

W. Watters, Edwin Chamberlin, G. S. Simons, T. W. Woodruff, San Antonio; I. M. Cline, Galveston; James C. Atkins, Portland; W. J. Hollingsworth, Brownwood; Marshall Burney, Kerrville; John Hord, Rio Grande City; J. A. Bell, Laredo, and others.

There was the enthusiasm and good feeling which is always evinced in a Texas gathering of any kind, especially when the people are united in a great cause.

Judge J. H. McLeary presided. After a brief address of welcome he said this was not a convention but a meeting of the Texas State Irrigation Association. "The objects and aims are to dot this country with irrigated farms, to make the desert blossom and to make that part of the country heretofore considered as only a stock range an agricultural country. When conducted by irrigation, crops are the most reliable, because whether it rains or not they can make the country rich and prosperous."

The secretary announced that the number of members in the association was 205.

A communication from the Southern Irrigation Congress was read, inviting Texas to send delegates to the next meeting of the Congress, at Nashville, in October, 1896.

A large number of interesting papers were read and discussed. Professor Hill of the United States Geological Survey read a paper on Artesian Well Irrigation, and explained at length the general subject of the economies of irrigation.

Like El Paso and the surrounding country, San Antonio being in the semi-arid region needs irrigation fully as much, from the fact that rains there are seldom, if ever, opportune. They come in quantities sufficient for all crops did they fall when needed most. The burden of all the papers read and the speeches made seemed to have been upon the conservation of the storm waters and the manner of conducting them out upon the land.

Mr. Bell, of Laredo, offered a resolution requesting all the Texas representatives in Congress to endeavor to have some of the government geological survey work provided for done in Texas, the purpose being to ascertain the amount of the State's water supply, information of exceeding value when a system of water storage is contemplated. Adopted.

EDWIN M. CHAMBERLIN,
of San Antonio,

Secretary of the Texas Irrigation Association.

After deliberation a plan was adopted for the thorough organization of the State by counties, the county associations to be part of the general State Association.

The election of officers resulted as follows: President, J. H. McLeary, San Antonio; first vice-president, F. A. Swinden, Brownwood; second vice-president, Edwin Chamberlin, San Antonio; secretary, W. D. Hornaday, San Antonio; treasurer, J. N. Brown, San Antonio; sergeant-at-arms, J. C. Carr.

The chairman named the following to comprise the committee on legislation: Henry Snyles, Abilene; C. E. Dutton, San Antonio; P. J. MacMahon, Laredo; F. A. Swinden, Brownwood; J. S. Taylor, Laredo; W. W. Turney, El Paso; William Casson, Zavalla county; J. L. Slayden, San Antonio; John Willacy, Portland; Robert W. Stayton, San Antonio; Albert Urbechn, Laredo; J. O. Nicholson, Laredo.

Authority to recommend to the governor appointments as delegates to the meeting of the Southern Irrigation Congress at Nashville was given to the executive committee.

Laredo was chosen as the place for the next meeting.

IRRIGATION IN THE SOUTH.

IRRIGATION was carried on here and there in various Southern States the past season. A Southern Irrigation Congress has just been organized and preparations are being made the present winter for general irrigation in 1896.

The meeting and organization at Atlanta was a great event. The City Council chamber was crowded. Dr. H. C. White, president of the Georgia State Commission of Irrigation, called the assemblage to order and delegates responded from all the Southern States. Hon. John Triplett, in behalf of the State of Georgia, the city of Atlanta and the Cotton States and International Exposition, welcomed the Congress in an eloquent speech.

The constitution adopted, among other things, provides that the organization shall be known as the Southern Irrigation Congress, and shall meet annually, officers being elected on the first day of each session.

State Commissions of Irrigation shall be created in each State represented in this Congress in the following manner: The delegates from each State shall recommend to the Executive Committee five proper persons in their State for appointment as members of the State Commission of Irrigation, and, if the Executive Committee approve, proper certificates of their appointment, for the term of three years, shall be signed by the President and Secretary.

The members of the Executive Committee are instructed to furnish the secretary of this Congress, from time to time, with statistics of irrigation in their respective States, that he may disseminate this information for the enlightenment of the people.

The work of this Congress is educational, and designed to bring out fully every fact connected with irrigation, embracing the proper drainage of land, the terracing of farms, the preservation of the forests and the utilization of the water-power at our command.

Officers were elected as follows: President, Prof. J. B. Hunnicutt, Athens, Ga.; vice-president, Hon. H. C. Gardner, Nashville, Tenn.; secretary, Major W. G. Whidby, Atlanta, Ga.; treasurer, Hon. John Triplett, Thomasville, Ga.; sergeant-at-arms, Hon. Wilberforce Daniel, Augusta, Ga.; postmistress, Miss Kate Brasington, Cincinnati, Ohio.

Executive Committee—Alabama, P. H. Mell, Auburn; Arkansas, Jeff D. Wellborn, Kerrs; Florida, O. Chute, Lake City; Georgia, C. J. Bayne, Augusta;

Kentucky, H. C. Underwood, Atlanta, Ga.; Louisiana, Dr. W. C. Stubbs, New Orleans; Maryland, H. R. Walworth, Baltimore; Missouri, Dr. C. E. Edwards, Kansas City; Mississippi, S. M. Tracey, Agricultural College; North Carolina, Wade T. Hampton, Raleigh; South Carolina, J. C. Hemphill, Charleston; Texas, A. M. Soule, College Station; Tennessee, T. H. Webb; Virginia, J. F. Jackson, Richmond; West Virginia, A. B. White, Parkersburg.

The Chamber of Commerce of Nashville invited the Congress to hold its next session in that city. The invitation was seconded with spirit by the City Council of Nashville, the mayor of that city, the Board of Public Works and the Tennessee Centennial. Accepted.

Addresses were made as follows: Hon. C. R. Pringle, "The Preservation of Our Forests;" Prof. J. B. Hunnicutt, "The Full and True Meaning of Irrigation;" Frank P. Chaffee, Alabama State Weather Service, "Distribution of Rainfall and Moisture in the Southern States;" Percy Sugden, "Irrigation and Drainage of the Land from a Southern Standpoint;" Dr. W. C. Stubbs, Louisiana, "Irrigation."

Prof. H. M. Wilson of the United States Geological Survey gave a lecture on the all-absorbing subject. Lute Wilcox, by charts, illustrated the various methods of irrigating land, imparting valuable information.

Papers were read as follows: Prof. A. M. Soule, "A Bit of Irrigation History;" Hon. J. S. Titcomb, "Suggestions;" Hon. J. D. Wellborn, "Irrigation in Arkansas;" Hon. J. E. Mercer, "Reclamation of Land by State Authority." Numerous talks and addresses were made.

The National Irrigation Congress sent fraternal greeting by four delegates—H. E. Heath, of Nebraska; Lute Wilcox, of Colorado; Frank Woodford, of Arizona, and A. E. Blount, of New Mexico.

The Tennessee Centennial Exposition is to be held at Nashville from September 1 to November 10, 1896, and the next session of the Congress will be held at Nashville during that time.

Among the resolutions was one giving the thanks of the Congress and of the entire South to Major W. G. Whidby,

secretary, for inaugurating the movement which resulted in the organization of the Congress, and also to the Southern Cultivator for effective aid.

At the closing of the proceedings President Hunnicutt made a stirring address. He urged prompt and effective work and laid stress upon the importance of the Southern States having a grand exhibit of the products of irrigation at the Tennessee Centennial Exposition.

A SOUTHERN IDAHO SYSTEM OF WATER RIGHTS.

BY J. H. LOWELL.

IN 1893 a company constructed a canal designed to water 15,000 acres of bench land between the Boise and Snake Rivers, at Roswell, Canyon county, Idaho.

The first idea of the promoters was to sell water rights and charge a fixed annual rental, as is the custom of similar enterprises in this State, but upon a careful study of the situation they arrived at the following conclusions:

1st. That the owners of the land should also have the absolute ownership and control of the water.

2nd. That the annual maintenance fee should be charged on every acre of land for which water right is purchased, whether the land be cultivated or not, and that it should be sufficient for the proper operating and repair of the canal and no more.

In the absence of any State law authorizing an irrigation district (such a law has since been passed, but is practically inoperative pending the result of the California litigation), a company was incorporated known as the Riverside Irrigation District, Ltd., which was stocked on the basis of one share of stock to each ten acres of land covered by the system.

Water can only be obtained by the purchase of stock in the company, and upon the face of each certificate is a description of the land to which the water is made appurtenant. Based upon this certificate of stock, the company issues a water deed, conveying to the holder of the stock his proportion of water, and making the same appurtenant to the land for which the stock is purchased.

Incorporated in the deed are some provisions considered necessary for the proper and systematic administration of the com-

ARTHUR W. PHILLIPS,

Of Douglas, Wyo. The author of the "Mineral Wealth of Wyoming," in this number.

pany's business, as for instance: Agreement as to control of gates and measuring boxes; to prevent undue waste; to restrict assessments to actual cost of maintenance; to provide method for levying assessments. By this means it is sought to guard against the sometimes loose methods of mutual or "farmers'" ditches.

This deed is duly recorded and is made binding on the successors to the parties in interest.

Stock can only be transferred on the books of the company upon the presentation of a duly executed deed for the land to which the stock is appurtenant. In case part of the land only is sold, it carries with it its proportionate share of stock.

It is sought to make the water belong to the land rather than to the individual, and this we believe to be the true theory of the appropriation of water.

When any land is sold, the stock belonging to it is simply transferred to the new owner and he holds the water right subject to the agreements and provisions of the original water deed.

Each purchaser of water stock is at once a full member of the canal company, entitled to vote, hold office and participate in all the company's business, and when

all the land under the system has taken water rights the canal will be entirely owned by the irrigators, who are the persons most vitally interested in its efficient and economical administration. This end being reached by degrees will obviate one source of trouble which has been felt under the California law, where men in the districts have been called suddenly to handle immense sums of money and large enterprises without previous experience or training.

At the same time the irrigator will obtain his water from the start at actual cost of maintenance. Under this system the annual assessment is estimated at not to exceed twenty cents per acre. Water stock sells at \$10.00 per acre.

The above is given as an outline of a conscientious attempt to give a community the benefits of a district system in so far as it lay in the power of private individuals to do so.

IRRIGATION IN ALBERTA, CANADA.

THE following is a letter from Chas. O. Card, of Cardstone, Alberta, in reply to inquiries regarding irrigation.

You ask me in regard to my ideas of duty of water. I believe in most instances that fifty cents per acre will give a handsome return on capital invested.

All this will naturally be governed by the area that can be irrigated under the canal and cost of the same. In Alberta it seems to me that such a vast area can be irrigated with each canal and the water supply is so abundant in these large streams. I have tested to some extent by observation and levels and the water can be put on the land more cheaply than in the mountain valleys, because in the latter locations the land is usually in small strips that skirt the mountains here. Several townships in many instances can be irrigated from the same canal. You mention the Calgary Irrigation Company's canal covering about two townships. The canal must pass over very rough ground to cost \$4.00 per acre; but I presume you left a margin. I believe the average cost of irrigation in Alberta will not exceed \$3.00 per acre. The reservoir system in connection with these canals will be of vast benefit not only to

the investors, but to the consumers. My knowledge of the reservoir system is that crops thrive much better and give a greater yield under water that has been warmed in reservoirs, than so direct from the coldwater that is chilled by the melting snow.

I am confident that from the beginning in this only partially arid country, we will not require more than fifty per cent of the water that they do in the mountainous districts. We have an excellent strata of clay under our soil, besides, we have more rainfall and more dew. I am confident that, in most instances, one thorough irrigation will mature our grain crops. Our vegetables will usually require more. Probably two or three times. My experience this past season in irrigating our gardens is that not to exceed one-half is required to what I used on the same crop in some of the Western States.

GREAT STRIDES BEING MADE.

THE admission of Utah to Statehood is a great stride in the progress of Western America; and Arizona, New Mexico and Oklahoma are knocking. The general situation is well and briefly described by the Industrial Reporter, under the caption, "See Us Grow." "The West has never had a brighter outlook than it has today. The great activity in mining has set the wheels of the commercial and financial West in motion and each month encouraging reports come from every section of the Mountain West in confirmation of this fact. There is probably more prospecting going on to-day than ever before in the history of the country, and this means consumption of supplies and employment for thousands of men. The rich discoveries being made almost daily in the mining camps of Colorado, Utah, Wyoming, Arizona, New Mexico, Montana and Nevada are attracting capital from the East and abroad, and there is now ample means at hand for developing such mining claims as present a favorable showing. Land values, too, are constantly increasing, despite the fact that thousands of acres are being reclaimed every year and millions of dollars expended in the construction of irrigating ditches, pumping plants, etc. The iron and coal industries are also rapidly developing under the

pressure of a sharp demand, and, indeed, every feature of our Western industrial development is moving onward and becoming a more powerful factor in swelling the grand total of our products and commercial importance. Building, too, is again reviving and the beneficial effect of the mining activity is to be seen in all the trades."

AN EMIGRATION BUREAU IN CHICAGO.

THE Canadian government is actively at work placing the resources and advantages which it has to offer in the Northwest before homeseekers, manufacturers and investors. An office has been opened in Chicago, where there is now on display an exhibit of the products of the provinces of Alberta, British Columbia and Assiniboia. The exhibit is at present comprised mainly of grains and grasses, with a few choice photographs of farming scenes and views along the line of the Canadian Pacific Railway. It is the intention to interest investors and manufacturers for the purpose of having them open the mines and establish factories, but the principal object of the work is to secure settlers and therefore the Dominion government is offering to the heads of families and other responsible persons a quarter section of land free.

Mr. Peter F. Daly, who has charge of the Chicago office, is an old railroad man and thoroughly understands the details of work of this character. His efforts are already having good results.

The Dominion government has taken up this work along the lines advocated by THE IRRIGATION AGE during the past few years and it now remains to be seen whether the various Western States will be as enterprising and energetic as our neighbor on the North. The only way to get settlers is—to get them, and the Canadians in the Northwest and the people of the Southern States are working very hard in favor of their particular localities. What will the West do?

TRANS-MISSISSIPPI COMMERCIAL CONGRESS.

The eighth annual session of the Trans-Mississippi Commercial Congress at Omaha was fully attended, there being

300 delegates. President George Q. Cannon, of Utah, was in the chair. Utah, Iowa, Missouri, Arkansas, Kansas, Texas, Colorado, California, Arizona, Nevada, New Mexico, Washington, Oregon, Wyoming, North Dakota and South Dakota were represented. The delegation from Utah was as large as that from Nebraska. Governor Holcombe's address of welcome was responded to by Ex-Governor L. Bradford Prince of New Mexico.

Some of the addresses were as follows:

Forestry in the Rocky Mountain Region, Hon. R. Park, of Salt Lake City; The Hawaiian Question, Hon. Hugh Craig, of San Francisco; The Nicaragua Canal, Capt. W. L. Merry, of San Francisco; Statehood for the Territories, Hon. Sidney Clarke, of Oklahoma, and Ex-Governor Prince of New Mexico; Trans-Mississippi Freight Tariffs, Hon. James V. Mahone, of Sioux City, Iowa, and Capt. Lon Bryson, of Davenport, Iowa; Cultivation and Uses of Ramie, Prof. Sylvester Waterhouse, of Washington University, St. Louis; Deep Water-ways, Hon. A. P. McGuirk, of Davenport, Iowa; Irrigation, Ex-Governor Prince and others.

The Congress declared for the free coinage of silver. Resolutions were also adopted in favor of government control of the Nicaraguan Canal, indorsement of ramie, appointment of United States irrigation commissioners, admission of New Mexico to Statehood, improvement of Mississippi and Missouri rivers, enactment of a National bankruptcy law, annexation of Hawaii and Cuba, construction of a railway from southern California to Salt Lake, speedy completion of the Hennepin Canal and favoring the deepening of Duluth harbor.

It was also resolved that the United States Congress be asked to take such steps as may be necessary to hold a Trans-Mississippi Exposition in Omaha during the months of August, September and October in 1898, and that the representatives of such States and Territories in this Congress be requested to favor such an appropriation as is usual in such cases to assist in carrying out this enterprise.

A resolution urging the various State governments to take legislative action relative to irrigation was submitted and passed.

Also a resolution urging the speedy construction of the proposed railroad from

Butte, Mont., via Boise, Idaho, to the Pacific coast. This will shorten the route to Duluth, at the head of the great lakes, from the coast 250 miles and from points in Idaho proportionately, giving the advantages of a part water and cheap freight route to the markets of the East.

Salt Lake was selected as the place for the next meeting.

COMING DECISION ON THE WRIGHT LAW.

Decision of the case under the Wright Law in California is soon due from the United States Supreme Court. The hearing was set for the first Monday in January, the 6th. There is general interest in this decision in the West, as it will have a bearing on the acts in all the States. Of the recent decision in Nebraska, the Omaha Bee says: "The importance of the decision handed down last week by the Supreme Court of Nebraska, affirming the validity of the irrigation act passed by the last Legislature is probably not fully appreciated by the people of the State. The court declared the act to be constitutional, and inasmuch as the Nebraska law is essentially the same as that of California, whose law was judicially declared by State courts to be unconstitutional, the decision of our highest court is of great interest. Of course the question may be taken to the federal courts, but the probabilities are in favor of the decision being sustained."

ILLINOIS STATE HORTICULTURAL SOCIETY.

THE recent meeting of the Illinois State Horticultural Society at Kankakee was a full one. The address of President T. E. Goodrich, of Cobden, was a resume of horticultural progress during the year. The reports of the treasurer and secretary showed the expenses of the society for the year to have been \$4,280.60.

The committees were as follows: Herick's essays, L. R. Bryant, H. Augustine, R. T. Fry; final resolutions, J. L. Hartwell, E. G. Mendenhall, G. J. Foster; treasurer's report, J. W. Staunton, George A. Bell, L. F. Small; fruit committees, central, E. A. Riehl, J. N. Fitch, J. I. McSpadden; northern, C. G. Winn, Archie Augustine, G. W. McCluer;

southern, J. V. Cotta, L. R. Bryant, O. W. Barnard; general collections, A. L. Small, S. W. Gilbert (of Missouri), C. H. Webster; vegetables, D. S. McKinstry, A. Hamilton (of Michigan).

Interesting and instructive papers were read by C. G. Winn and L. R. Bryant, and discussed by the members.

During the session one hundred members of the society, with their wives, accepted the invitation of Dr. Clarke Gapen, the superintendent, and visited the irrigated farm of the Illinois Eastern Hospital for the Insane, and also the hospital.

J. N. Fitch, of Cobden, read a paper on cherry, peach and plum culture. W. S. Perrine, of Centralia, presented a revised fruit list for Southern Illinois. Prof. S. A. Forbes, of Champaign, State Entomologist, spoke upon recent progress in agricultural entomology. William Gould, of Villa Ridge, read a paper on the varieties and cultivation of grapes.

About \$400 was distributed among the successful exhibitors of apples, pears and grapes. E. A. Riehl, of Alton, made a report on work in the experiment stations, which was most favorable to them. G. J. Foster, of Bloomington, presented a revised fruit list for Central Illinois.

In a general discussion as to whether the spraying of fruit trees was beneficial, a majority thought it was. H. L. Doane, of Johnsonville, read a paper on the varieties and cultivation of small fruits. Prof. Eugene Davenport, of the University of Illinois, made an address on the use of home-made fertilizers, with especial reference to green manure. G. W. McCluer, of Champaign, assistant superintendent of the State Experiment Station, read a paper on the benefits to be derived from thorough and clean cultivation.

One evening during the session, Dr. Gapen, on invitation, made an able and instructive address on irrigation in Illinois, which was listened to with rapt attention. The doctor gave facts on the simplicity and cheapness of this safe plan of farming which created general surprise and deeply interested his audience in the subject.

Officers elected were: President, T. E. Goodrich, of Cobden; vice-president, L. Small, of Kankakee; secretary, H. M. Dunlap, of Savoy; treasurer, Arthur Bryant, of Princeton.

Springfield was chosen as the next place of meeting.

THE IRRIGATION CAUSE IN NEBRASKA.

THE Nebraska State Irrigation Convention, at Sidney, was largely attended and a pronounced success. There was the greatest enthusiasm in the irrigation cause, and this meeting will give irrigation in Nebraska a great impetus. The papers and discussions were of unusual interest. The first resolution was by Mr. W. W. Mason, of Douglas, and favored the holding of the Trans-Mississippi Industrial Exposition in 1898 in Omaha. It was adopted. The report of the Committee on Resolutions on various subjects was adopted, as follows: Establishment of irrigation reservoirs by the Government; the offering of premiums by the State for the wind-mill and other machinery for raising water from wells for irrigation purposes; early adjudication by the Government of matters relative to the waters of inter-state rivers; amending the laws regarding the building of irrigation ditches across Government lands; requesting Senators Thurston and Allen to enter their names in the United States Supreme Court as attorneys in the Wright Irrigation Law case, in behalf of the State of Nebraska; inquiring concerning the expenditures of moneys heretofore appropriated by the Government to advance the cause of irrigation, and calling upon the next Legislature to appropriate money necessary to sink three test artesian wells.

Officers elected were as follows: President, A. G. Wolfenbarger, of Lincoln; secretary, James L. McIntosh, of Sidney; vice-president-at-large, H. E. Babcock, of Ord; treasurer, R. S. Oberfelder, of Sidney; state lecturer, I. A. Fort, of North Platte.

The next annual meeting will be held at Lexington, in October.

HOW TO IRRIGATE IN ILLINOIS.

D. R. Clarke Gapen's address before the Illinois Horticultural Society contained many necessary points for new beginners in irrigation in Illinois and the central Western States generally. Extracts are made here and there:

If you had to sell one-fourth or one-third of your land to establish a good irrigation plant, you would be the richer in the outcome.

A soil to which is given all the water it can use, will produce four times an average product.

With ordinary water irrigation land previously yielding ten bushels of wheat per acre, under irrigation yields sixty bushels per acre; and lands which were worth from \$2 to \$10 per acre increase in value to \$300 per acre.

It makes but little difference what kind of water is used, just so it is wet. It does not need to be clean water.

Irrigation in the humid regions will undoubtedly be individual rather than co-operative in character. What then are the means by which an individual, or at most two or three individuals, acting together, may secure to themselves an irrigant plant? In a very few cases this may be done by building a dam across a stream and diverting the waters into a channel, which will be carried around on the higher ground and utilized by those owning the land farther down the stream, as is done in Colorado. But, in the main, I take it, irrigation in the humid regions will be used by horticulturists and garden or truck farmers, and in this case only tracts of from ten to forty acres will be irrigated. In these cases the water will have to be raised, probably by some form of pumping machinery.

By means of improved and comparatively inexpensive pumping machinery it is now found possible to deliver water at a very small cost.

The wind-mill would not have a sufficient capacity to deliver the amount of water needed if the water was wholly used during the time the pumping was going on. A reservoir with a capacity of several million gallons may be constructed at a comparatively small expense, and into this reservoir the wind-mill pumps throughout the year, filling it up and affording a supply which will be drawn off during the irrigation season.

Probably, however, the most economical method of delivering water is by means of the centrifugal pump. This pump will raise water to a height not exceeding 50 feet, at a cost not to exceed 20 to 30 cents per million gallons.

Piping for the pumping of water is not costly.

While, as I have before intimated, it is in horticultural and truck gardening that

the best usefulness of irrigation is to be found in this region, yet any crop may be largely increased by irrigation.

A PLANT IN WISCONSIN.

THAT Wisconsin is going into irrigation is evident from the following description of a new plant near Madison owned by Mr. George Raynor, of the Madison Democrat. That gentleman writes to THE IRRIGATION AGE:

"I am laying 3,300 feet of six-inch standard cast-iron water pipe to reach the three high points of a 100-acre farm adjoining Madison and on the shore of Lake Mendota. I will place at the lake a 25 horse power gasoline engine and rotary pump. The plant as it is now being put in will cost \$2,000 or \$20 per acre. About one-fourth of the water will have to be lifted 100 feet, and three-fourths about 60 feet. I expect to raise 30,000 gallons per hour and hope that the rains will supply the land until July and that after that two irrigations of four-acre inches each will answer. I expect to put the eight-acre inches on the entire 100 acres at a cost of \$2 per acre annually for fuel and one man to attend engine and distribute water. To this will be say six per cent on the \$20 per acre, making in all nearly \$3.25 per acre annually. The crops will be timothy, clover (I will also try four acres of alfalfa this year), apples, of which there are now 250 bearing trees, a few plums, cherries, grapes, potatoes, cabbages and other garden truck. I believe there is not any as extensive irrigation scheme as I am at work on to be found in this state. The advantages I have are: First, abundance of the very best water; second, the very best drainage; third, rather easy distribution of water when once raised to the three high points. The one great disadvantage is the extreme mechanical lift of from 60 to 100 feet."

INDIANA, OHIO, MICHIGAN, MINNESOTA AND
IOWA CONVINCED.

In Indiana and Ohio several artesian wells are being sunk. At the recent meeting of the Michigan Horticultural Society the operations of the experiment station in that State in irrigating garden truck were described. The yield was six-fold

greater. Members also testified to the great success of irrigation in their orchards the past season. Minnesota has caught the "well fever" from South Dakota, and numerous wells are being sunk. There is a general movement for dams and artificial lakes or reservoirs. Iowa is sinking wells, but the irrigating canals will also obtain in that State. One extensive enterprise has already been commenced upon, known as the Iowa Irrigating Ditch Company. The incorporators are A. A. Newkirk, Clover Sickler, Wilson Marsh, Charles A. Bryam and Frederick Marsh, who are South Dakota and Iowa men. They propose to operate an irrigating canal and will construct immense reservoirs in which to store surplus water during the winter and early spring. Survey work on the canal has just been completed.

Wisconsin cranberry growers are all going into irrigation.

KANSAS PUSHING AHEAD.

Kansas development made great progress during 1895, and her people have seen to it that the fact was put on record. The demonstration at Music Hall in Chicago just as the great display at Battery D was about closing was a telling stroke. The speeches of Governor Morrill and Mr. Burton were fully reported in all the Chicago papers, and a good notice was sent broadcast through the Associated Press dispatches. That the United States and Europe know all about Kansas prospects there can be no sort of doubt. W. C. Edwards, secretary of state, projected the Music Hall meeting and raised the necessary funds. Among those on the stage were J. S. Emery, E. R. Moses, L. F. Frizell, E. G. Hudson, E. Stanley, J. V. Beekman and E. Wilder. Mr. Ingalls was to have been the principal orator but his trains failed to connect.

THE RUSH OF EVENTS.

A large project is on foot in the Platte valley, in Colorado, involving the construction of a storage reservoir covering something like 8,000 acres, holding water sufficient to water over 100,000 acres of land.

Adjudication is in progress respecting the rights of priority on the Laramie River and its tributaries in Colorado.

In the valley of the Cache a la Poudre

the reservoirs enter the winter nearly all supplied with water to their full capacity, or as much as the managers think is advisable to attempt to carry through the winter. This is better than ever before, due partly to the larger rainfall of the past year.

The return of waters which have been once applied in irrigation has become an important source of water supply in the irrigated districts of Colorado where irrigation has been carried on for some years. The most careful investigation of these has been made on the Cache a la Poudre and on the Platte rivers, the investigations having been carried on now for nearly ten years, principally under the direction of Professor Carpenter of the State Agricultural College of Colorado at Fort Collins. The last measurement, made a few weeks since by Professor Carpenter and by Mr. Preston, of the State Engineers' office, shows large gains over previous years. The Experiment Station of Colorado will soon publish a bulletin by Professor Carpenter on the subject, giving the results of the last ten years of measurement, with the conclusions formed by the present knowledge of the subject.

The researches in irrigation of Professor L. G. Carpenter of the Colorado Agricultural College of Colorado have been recognized by the Government of France by giving him the decoration of Chevalier du Merite Agricole, "for distinguished services to agriculture." This is one of the first, if not the first time the decoration has been conferred on a foreigner.

Secretary Hoke Smith is savagely taken to task for refusing to open the Uncompahgre Indian reservation, in Utah, in compliance with the act of Congress. Rich mineral deposits have been discovered.

Much importance is attached to the fact that Australian salt bush flourishes on alkali lands. It is urged that the millions of acres of alkali lands in the West can be transformed into dairy pasturage.

The Culbertson (Neb.) Era exclaims: "Darn the gold mines. . . If each Nebraska county which claims to have found one had only discovered an artesian well instead, every patriotic citizen would shout hosannas."

The work of surveying and subdividing the Indian Territory is shown to be progressing rapidly in a report made by the geological survey. The total amount of land surveyed during the last month was 1,500 miles. There are also 498 square miles reported as topographically mapped out during that period.

Farmers in fourteen Western States are in luck. The government weather bureau has organized these States into districts, so that farmers will be warned by telephone, telegraph and signal at least twenty-four hours in advance of blizzards.

ARIZONA.

Canaigre is being shipped from Phoenix to Liverpool, England.

The Arizona Improvement Company sold their Salt River valley oranges to a Chicago firm at \$7.00 per box.

The Gila valley is fast coming to the front. The large alfalfa fields and orchards and the comfortable homes at Thatcher, Layton, Safford and Pima indicate the prosperity of the people.

Some of the Montana buyers are in Arizona already picking up cattle for delivery next spring; 1896 is going to be a better season for the cattle trade.

The report that Judge A. C. Baker had ruled that Pima Indians are by treaty citizens of the United States has proved erroneous.

The cultivated portions of Arizona are worked almost entirely by irrigation. In the mountains are a few tracts where something is raised on the rainfall.

Deer Creek coal fields are found to be very rich and the benefits that would arise from the opening of these fields and the erection of coke ovens at the mines would be almost incalculable. It would give a great boom to mining and smelting for one hundred miles around, and would be of especial advantage to Globe.

The Interior Department has commenced the work of allotting lands to Indians in severalty and the matter is in the hands of C. N. Bennett, the private secretary of Secretary Hoke Smith. Mr. Bennett is now in Phoenix and will commence the division of the Gila Bond, Pima and Maricopa Indian reservations into ten-acre tracts. The land is of good quality and can be

irrigated. The great Sacaton reservation on the Salt and Gila rivers will not be allotted.

Governor Hughes describes the situation as follows: "The statistics of last year show Arizona to be enjoying more than average prosperity. We have more than five hundred thousand acres under cultivation. We have reservoirs and canals under construction which will add more than half a million more within the next two or three years. Our exports in value last year reached nearly fifteen million dollars of products of mines, farms and range. I believe this output will be doubled during the present year."

CALIFORNIA.

California alone has, up to date, produced \$1,350,000,000 in gold. Africa's total product has been \$118,000,000.

Calaveras county, which had never reached the top of the ladder since the discovery of gold, has jumped to the first place as the greatest gold producer in the State, owing to the fact that its aggregate output in gold in 1894 was \$2,124,548. Thus it increased \$464,856 over 1893 and \$1,375,017 over 1892. The total production of gold from 1880 to 1894, inclusive, was \$11,647,495.

Irrigation has made great progress in California during 1895, and still the work goes on. A favorable decision from the United States Supreme Court on the Wright Law is expected during the present month.

A new incorporation is the Sierra Development Company, at Sansalito, \$250,000, with \$2,500 paid in, to build dams, reservoirs, ditches, etc., for irrigation.

West Side Suburban Water Company, at Los Angeles, \$2,000,000, with \$7,000 paid in; to build dams, ditches, canals, etc., for irrigation.

Pacific Water Company, at Kings City, \$300,000, with \$200,000 paid in; William E. Ward, Benjamin S. Coppock, H. V. Morehouse, A. L. Burbank, San Jose.

The Corina Land & Water Company has been incorporated. Capital, all paid in, \$25,000.

The South Tule Independent Ditch Company has been organized. Capital stock, \$24,000.

Squaw Lake Water & Mining Company, \$1,152,000, all paid in, to construct ditches, tunnels, etc., for irrigation purposes. The incorporators are San Francisco and Portland (Ore.) men.

Paladale Town Company, at Los Angeles, \$100,000 with full amount paid in; to build ditches, canals, reservoirs, etc., for irrigation purposes.

Patents have just been issued as follows: 550,710; irrigation headgate; to James M. Eads, San Bernardino, Cal. 550,711; irrigation headgate to same inventor. 548,779; irrigation hydrant; to George A. Doyle, Perris, Cal.

Mexican Water Pipe Company, at Los Angeles, capital, \$500,000; directors, W. L. Carter, O. C. Hinman, John T. Gaffey, M. J. Nolan, G. A. Smith, Los Angeles.

Southern California Improvement Company, at Los Angeles, capital, \$500,000; directors, Bruce E. Ritchie, Hinsdale, Ill.; J. M. Stewart, Chicago; W. E. Robinson, C. E. Crowley, John Love, Los Angeles.

Final surveys are being made for the San Lorenzo Water Company's proposed irrigation system at King City, Monterey county. The height of the dam will be 100 feet, and will impound sufficient water to irrigate about 15,000 acres of level and fertile land in the vicinity.

Southern California Mountain Water Company, at San Diego, \$3,500,000, with full amount paid in. This company succeeds the Mountain Tecarte Company in constructing the irrigation system of that company, which includes four large dams, and is calculated to irrigate most of San Diego county south of the San Diego river and west of the main range.

California is now competing largely with France and Italy for the dried fruit and canned fruit trade of Mexico.

The 27th anniversary of the founding of the Patrons of Husbandry was celebrated at Stockton on the 7th of December.

The Los Aguilas ranch, consisting of 23,650 acres, in San Benito county, was knocked down to Andrew B. McCreery for \$80,000.

It is a fact that California is knocking out Baltimore and Maryland in the canned goods industry of the United States.

Over 40,000 40-pound sacks of peanuts were raised in Orange county the past

season, and the price realized, from the crop was from $3\frac{1}{2}$ to 4 cents a pound.

California the past year has produced and packed enough prunes to give every boarder in the United States just four pounds.

Claus Spreckels, the sugar King, says he will invest \$1,000,000 in three new beet sugar factories in California.

There is a prospect of a beet sugar factory at Anaheim in the near future, an Eastern syndicate having taken hold of the proposition in earnest.

The San Bernardino, Arrowhead & Waterman railway, and the Harlem Springs resort are both about to be sold, and everything points to F. Kohl, of Centralia, Ill., as the purchaser.

A Perris rancher reports a second crop of ripe peaches during 1895. The fruit was not so large as the first crop, but was well matured and of fine flavor.

In one week San Jose shipped East 551,870 pounds of canned fruit, 1,014,925 pounds of green fruit, 4,026,285 pounds of dried fruit, 107,280 pounds of wine, and 170,850 pounds of garden seed.

P. W. Morse, of the Watsonville Beet Sugar Factory, announces that there will be no reduction in the prices paid for beets by his company next season. A straight price of \$4.00 per ton, irrespective of sugar content, will be paid.

Another industry is about to be developed in Southern California. The first cargo of guano ever taken from the Channel islands, off Santa Barbara, was brought into that place recently.

The Antelope Valley Association is the name of a strong organization just completed and composed of all those who are interested in the welfare of Antelope valley and are willing to work for its progress. It will work for the whole valley as the Los Angeles Chamber of Commerce acts for Southern California.

The newspapers are urging the organization of fruit growers, so that the profits of middlemen may go to the producers. Small farms and diversified crops are also advocated. THE IRRIGATION AGE is well read throughout the State.

COLORADO.

The mining improvement is not local to Cripple Creek. The whole State is involved.

Taking the State as a whole, the increase of population can not be less than 300 daily, or at the rate of 100,000 a year.

Notwithstanding the mining excitement, agricultural lands are selling and irrigation enterprises are being pushed forward.

The good effects of the remarkable mining development in Colorado are directly apparent in the increased State revenues.

The railroads are reaping a harvest, and the officials are in a happy frame of mind.

W. S. Stratton, the luckiest single mine owner at Cripple Creek, is arranging for the erection of a large electrolytic reduction works, either at Cripple Creek or Colorado City.

It has been discovered that almost nine-tenths of the West Creek district, one of the new gold fields, is in a United States timber reservation, and persons working there are liable to imprisonment for trespass.

From the Gilpin district \$75,000,000 has been taken during the past thirty years, and the product averages \$2,500,000 a year.

The Leadville district is yielding heavily of gold, but generally mined from deep levels. Depth in all districts shows no signs of exhaustion. In the Gilpin district some of the mines are down 2,200 feet. There are scores of producing districts in the State.

It is not to be understood that all of the 600 companies organized and claiming ownership of properties in the district of less than thirty square miles are dividend-payers. Of 125 of these companies that are considered worthy of note, in the stock of which there has been more or less trading, only nine are reported as dividend-payers, thirty-two are producing, fifty have some ore in sight (generally of too low a grade to ship), and thirty-four own prospects that they are about to develop.

Of a monthly production now amounting to fully \$1,000,000, the greater portion comes from those classed as producing mines, and the proceeds are generally reinvested or are used in operating expenses.

The estimated Colorado products for

the year 1895 including the mining, agricultural, and manufacturing, was over \$100,000,000.

Carver Remington, of the Remington Typewriter Company, Chicago, has been elected vice-president of the new Mining Exchange at Cripple Creek.

Sales at Colorado Springs on Tuesday, December 24, aggregated 1,000,000 shares.

In his contest for the ownership of the Plymouth Rock mine, W. S. Stratton, the Bonanza King, has been successful, defeating D. H. Moffat.

IDAHO.

For a place where "no great rush is anticipated" the Nez Perces reservation is receiving its fair share of attention. The best of it is that most of the homesteaders will be actual settlers, not speculators, and next season the land will be covered by growing crops to tempt the railway builders on to Central Idaho.

Since the discovery of gold in 1860, Idaho's mines have annually produced about \$6,000,000 worth of precious metals. In 1890 the mineral output of the State was \$14,000,000.

The lands of Idaho are classified as follows: Grazing, 25,000,000 acres; agricultural, 15,000,000; timber 7,000; lakes and rivers, 1,000,000 acres. To those must be added several million acres of mineral and mountainous lands.

The United States Government has made an agreement with the Bannock Indians to build an irrigation canal fifty miles long in the Bannock reservation for irrigating about 150,000 acres, the water to be taken from Snake river.

The Washoe Irrigation & Power Company has been incorporated, \$20,000 to construct a canal in Canyon county, taking water from the Payette river, for irrigating the lands in the Washoe bottom.

The commissioner of Indian affairs is about to make another effort to have the Fort Hall, Idaho, reservation irrigated, so that it may be of some use to the Indians as farm lands.

KANSAS.

There is general satisfaction throughout the State over the exhibition train of the Kansas Million Club, the display in Battery D, at Chicago, and the concluding grand mass meeting at Central Music

Hall. The good work of attracting immigration to the State will be energetically continued. Irrigation is all the rage, and it has proved most wonderfully successful. The number of irrigators in 1895 was 1,638.

D. M. Frost, president of the Kansas Irrigation Board, from ten acres in Finney county produced the past season two and one-half tons of sugar beets, 200 bushels of tomatoes and 1,036 bushels of sweet potatoes.

The fruit growers of Wyandotte county now have upwards of 20,000 barrels of apples in cold storage. This is an experiment, and if successful hereafter apples will be stored in the fall instead of shipped, giving the growers instead of the speculators the benefit of the advance in price.

Leading creamery managers of Kansas have formed what is known as the Kansas Creamery and Supply Company, including nearly all the creameries of the State, and will make united effort to secure the market of the South.

Capt. W. S. Tough, formerly United States Marshal for Kansas, and who has for so many years managed the Kansas City stock yards horse and mule market, is to deliver an address before the annual meeting of the Kansas Board of Agriculture, on "The Horse Situation and its Future Outlook."

Many of the larger farmers, who can afford it, have cribbed their corn and are holding for better prices. Many more, however, have sold out at 15 to 17 cents per bushel.

W. C. McClain, of Huron, cashier of the State bank of his town, built cribs large enough to hold 15,000 bushels of corn.

George M. Munger has an irrigating plant located at his Catalpa Knob fruit farm, seven miles south of Eureka, in Greenwood county. The water supply is furnished by an artificial pond, which with the dam now constructed, will cover about 100 acres.

A coal mine has been opened up on the farm of John Hulsey, near Port Williams, and people in that vicinity will burn coal to a certain extent this winter.

The twenty-ninth annual meeting of the Kansas State Horticultural Society was

held at Lawrence. It had a big attendance and was a success in every way. The papers were interesting and instructive.

It is understood that the Standard Oil Company has acquired almost undisputed possession of the Kansas oil fields.

The commissioners of Shawnee county have decided to build a bridge across the Kaw river into Topeka. It will cost \$150,000.

Among the new topics introduced at the meeting of the Kansas Dairy Association was that of Pasteurizing milk and cream, and the process is finding considerable favor in other States, according to the reports.

The Rock Island is putting in a dam at Phillipsburg and next will put one in at Smith Center. The latter will cause an extensive lake to form.

Martin Mohler has taken a fancy to English Berkshires. He will raise no more wheat. Instead he will plant Kaffir corn, sorghum and other forage crops for hog feed.

The Kansas corn crop for 1895 is about 201,457,496 bushels.

N. H. Stidger is the father of irrigation in Ness county, says the Ness County News. He urges that it will pay any man to irrigate a garden spot, if he has to pump water by hand.

O. P. Updegraff, secretary of the Kansas State Swine Breeders' Association, says: "The foundation swine stock in our State has already given us a great reputation, and careful attention to our business will put millions of dollars in our pockets. Let us put forth a grand effort to further the interests of our association. It's like that household necessity, the baby buggy—'a good thing, push it along.'"

The farmers of Stanton county were never in as good shape financially as now. The past has been a year of plenty with them.

In 1894 Kansas had 90,825 acres in alfalfa, and in 1895, according to official returns, very close to 125,000, which is an increase of 38 per cent.

The Osage Carbon Company's pay roll on Saturdays is \$20,453.29. They also pay \$869 to the Scandinavian Company. At Scranton their pay roll is \$6,889.73.

Finney county farmers are paying their taxes promptly. Irrigation did the business.

Stafford county farmers have discovered that a profitable crop for them is celery.

Fourteen extra fine spring pigs raised in Chautauqua county weighed 4,280 pounds.

Liberal is becoming noted as a health resort.

MONTANA.

"It is only during the last two or three years that the people of Montana have turned their attention to gold mining, and this period has been characterized with discoveries and developments of gold belts which, judging from their immensity and richness, will eventually place Montana at the head of gold-producers, as well as that of copper." This is the claim of the State press.

The most important recent mining deal in Western Montana was that which occurred in Deer Lodge, whereby W. A. Clark became the owner of Willard Bennett's interest in the Royal Gold, which is one of Granite county's biggest gold-producers. The transfer includes all of Mr. Bennett's stock, consisting of 120,000 shares, at a price of about \$1 per share.

A batch of thirty-one patents for settlers on homesteads within the Helena land district was received at the land office in one week.

It is a fact not generally known that Butte produces 2,000,000 tons of copper ore annually.

The Helena mineral land commissioners have examined and classified 216,600 acres of land, and but one protest has been filed in the local land office.

Deeds transferring the site of the State School of Mines, which will be built in Butte, have been recorded, and the necessary buildings will be constructed in the spring.

The Belt and Sand Coulee coal mines of Cascade county now produce nearly 5,000 tons of coal a day. The pay rolls of these two companies aggregate \$125,000 every month.

The Last Chance Ditch Company at Joliet, Carbon county, has been incorporated; \$5,000; Andrew Nerlin.

The crop statistics of Gallatin county

average as follows: Wheat, 40½ bushels; hard wheat, 34 bushels; oats, 57.96 bushels; hay, 1.48 tons; barley, 47.24 bushels; peas, 23 bushels; potatoes, 247.8 bushels.

NEBRASKA.

The favorable decision of the Supreme Court establishing the validity of the district irrigation law will have an astonishing effect in reviving agriculture and commerce in Nebraska. Thousands of acres of semi-arid lands will at once be reclaimed and rendered as fruitful and productive as the most favored agricultural regions in any part of the United States, and the assurance of the crops in the irrigated portions will be made a matter of certainty so that the owners of these lands will be able to sow and reap regardless of rains or hot winds.

A proposition submitted to the Lincoln and Dawson county irrigation district, comprising 40,000 acres of land lying on the north side of the Platte river in Lincoln and Dawson counties, to vote 6 per cent bonds to the amount of \$275,000 was carried by a majority of 84 to 18. The canal will be 62 miles long, with 115 miles of laterals and will be 100 feet wide at its head.

In Western Nebraska there are several windmill plants from each of which thirty to forty acres of ground are irrigated. It seems that irrigation by windmills has made very rapid strides in Nebraska during 1895.

The construction of an irrigation ditch in Holt county is proposed. The ditch is to draw water from the Niobrara and Snake rivers in Cherry county.

The artesian well drilled for S. W. Davis on his farm in the Ponca valley is completed. The depth is 770 feet and water bearing rock 25 feet thick was drilled through. A gusher was struck that flows 6,000 gallons of water an hour through a three-inch pipe and has a pressure of 30 pounds to the square inch, throwing a stream 30 feet into the air.

The owners of the gold-bearing lands in the vicinity of Milford are going steadily ahead with projects for developing their properties, and in a few weeks it will be definitely known what the prospects are for making Nebraska a gold-producing state. Prof. Herbert Bartlett compares the formation and quality at

Milford with that of South America, Australia and other gold fields explored by himself.

A correspondent at McCool Junction writes: "While it is believed that gold can be found here in the valley of the Blue, the flowing wells are considered by farmers as of much more value than the prospective wealth of the gold fields. The flowing wells are being found near McCool. Two wells have been located in this county and a number of farmers near here are going to bore for the artesian flow. One thing is peculiar about this artesian flow. Men using common well augers bore down to a depth of eighty to 125 feet and an abundance of water gushes up about three to six feet above the surface."

State Engineer Howell and secretaries Akers and Bacon of the state board of irrigation are preparing to adjudicate 181 cases involving claims for water in the Republican river watershed. Twelve of the cases also involve contests for water rights, but Engineer Howell believes that he can dispose of the entire lot by the middle of the present month.

This is the truthful way the Culbertson Era puts it: "Alfalfa vs. the Mortgage. They will never stay long on the same farm. Incompatibility of their temper. If the alfalfa stays, the mortgage must go."

The trouble between the sugar beet growers and the factory people at Norfolk, growing out of the refusal of the factory to accept the beets under the contract, has culminated in a big law suit against the company. This will undoubtedly throw more light upon the question as to the correctness of the findings of the company's chemists in tests reported.

Last month's disbursements at the Table Rock creamery amounted to \$16,537.

Ten thousand fish have been distributed in Cheyenne county by the state commission.

Fred Smith, a Buffalo county farmer near Ravenna, raised thirty-five acres of sugar cane and is now making sorghum at the rate of 100 gallons per day. He will have 2,000 gallons, which will net him \$800.

At the recent meeting of the inter-state association of state fair managers at Chi-

cago Ex-Governor Furnas of Nebraska was re-elected president of the association.

Dr. W. H. H. Dunn, who farms near Lincoln, has found hemp a very profitable crop.

Northwestern Nebraska is long on hay and short on cattle. There should be thousands of young cattle up in that country. But the fact is that the whole country is short on cattle.

Nothing could be more direct! none with the demands of the hour than extensive cold storage facilities at some central point, as Omaha, for instance, for caring for the dairy and fruit products of Nebraska and Iowa.

"Alfalfa is all right and so are sugar beets," says Peter Youngers, of Geneva, "but as for me I propose to stand by the sub-soil plow through thick and thin."

NEW MEXICO.

The Marguerite Canal Company has bought the Pioneer canal at Barstow.

A large tract of land, of about 2,100 acres on the lower Mimbres near Deming, was sold recently by Mr. Spaulding to a stock company organized in New York. It is the purpose of the company to turn this vast area of land into a canaigre farm.

The building of the El Paso, Chicago & Mexican railway will be commenced some time during the latter part of this month.

Papers have been filed with the secretary of state incorporating the Albuquerque, Colorado & Pacific railroad, capitalized at \$100,000.

It is believed that the Wichita reservation will soon be open to settlement.

The sugar beet factory in the Pecos valley seems to be assured.

NORTH DAKOTA.

There is the same opportunity in this State to irrigate by means of artesian wells that there is in South Dakota, and numerous contracts are being let for the sinking of wells.

The Grand Forks Plaindealer says there is enough fuel beneath the soil of North Dakota to furnish heat for the entire nation for years.

Bismarck business men are agitating the question of building a railroad for

twenty miles north of that city to the coal fields. Experts estimate that a section of land containing the coal will produce 5,849,088 tons.

The Sherbrooke Tribune is authority for the statement that Hon. J. O. Smith had 750 acres of flax on his Plainview farm in Newburgh township the past season from which he gets over 12,000 bushels of flax.

OKLAHOMA.

One of the largest and most representative conventions ever held in the Territory in favor of Statehood has just adjourned. The population now is 275,000.

Taxable property in Oklahoma increased from \$19,947,922.86 in 1894 to \$39,275,189.21 in 1895.

Secretary Lowe, of Oklahoma Territory, has issued a charter to the Santa Fe, Oklahoma & Western Railroad Company, which also includes a land and town site company, capital stock being fixed at \$1,500,000.

The value of alfalfa for Oklahoma is emphasized by the behavior of the crop at the agricultural experiment station.

Canadian county land is quoted as more valuable than that of any other county in Oklahoma.

The report respecting the leasing of school, college and public building lands in Oklahoma is very satisfactory, and shows the net proceeds for the year 1895 to have been \$88,627.97.

The governor asks that all the public lands in the Territory, not filed on at this time, be donated to the Territory for the use and benefit of public schools.

OREGON.

A rich discovery of gold quartz is reported from Baker City. The discovery was made by George McCarty in the Virtue district at a depth of 20 feet. The ledge is five feet wide, the ore showing gold in large quantities.

The American Bar Company, at Klamath river, near Ashcreek, has taken out considerable gold this season, realizing as high as \$200 per day in some clean-ups.

The secretary of the Oregon Board of Horticulture estimates that there are 565,000 acres of pit and core fruit in the State, and 1,500 acres of a berry variety. There are

35,000 acres set to prunes, the estimated yield being from 80,000 to 100,000 pounds dried, in one orchard of twenty-three acres.

It is reported that the Bellevue mine has been disposed of to the Standard Oil Company for \$210,000.

A colony of fifty people from Scotland will locate in Grand Ronde valley.

Many tons of chittim-wood bark are shipped weekly from Halsey to San Francisco to be made into bitters.

Oregon produced 80,000 bales of hops the past season. If weather had been better, and prices had warranted it, the yield would have reached 110,000 bales.

The total amount of wool in the grease scoured by the Pendleton scouring mill the past season was 2,171,504 pounds. The amount of clean wool from this was 566,252 pounds.

SOUTH DAKOTA.

Farmers have been greatly encouraged by the prospects of irrigation from artesian wells, and are not nearly so anxious to sell out as they were early in the fall. Artesian wells are being bored in large numbers, and an abundant flow of water is invariably found at a depth of from 250 to 300 feet. Irrigation will be tried on an extensive scale during 1896.

Work is progressing rapidly on the Steimer & Shrader artesian wells. Brule county will probably have a dozen new artesian wells by spring, and quite a number of irrigated farms next season.

Oschner Bros, of Kimball, say the outfit is now being placed in position for the commencement of drilling on the artesian well.

Judge G. H. Carroll, of Miller, is an enthusiastic advocate of irrigation.

Frank Morris of Tripp is selling irrigated land.

A. E. Swan, of Swan Bros., of Andover has gone to Forest City to make arrangements for sinking an artesian well for the government at the Indian agency.

An exhibition train bearing products from the Big irrigation farm near Mellette; and from others in the State, is making a winter tour of the East and South.

The actual cost of irrigation in South Dakota is fifty cents per acre.

A report from Mellette says that F. R.

Ryerson, of Spencer, Iowa, has purchased W. W. Taylor's interest in the famous Hunter irrigation farm.

Johnson and Mahanna have completed the six-inch artesian well on the county poor farm, one and a half miles from Pukwana, and it is one of the finest wells in the county. It is 925 feet deep and throws a stream of water, clear as a crystal, forty-one inches above the pipe.

TEXAS.

John Willacy, of Portland, has filed with the County Clerk of San Patricio county, statements and estimates for the construction of two enormous dams across the Nueces river, one twelve miles and the other twenty miles from Portland. It is proposed to construct a canal from the first dam to Portland. The same will be under the control and management of the Nueces Bay and Irrigation Company. The upper dam will be operated by the Nueces Valley and Irrigation Canal Company. It also will consist of a canal of about eight miles in length between the upper and lower dams. As these dams will never fail to fill less than four times a year (owing to the enormous territory that the Nueces river drains) it will be easily understood that a very large body of land can be irrigated therefrom.

Laredo is to have in the near future one of the biggest irrigation industries in existence. Captain Wm. Anderson has at last succeeded in enlisting capitalists in New York and Chicago in the enterprise. Mr. R. Walker, who has been operating the coal mines under a lease, sold out his entire interest to these people, they paying him \$11,000 for his unexpired lease. The new organization has arranged to purchase the entire Santo Tomas tract, consisting of 43,000 acres of rich coal fields. Preparations for irrigating these lands in connection with mining are now being made.

Another big Texas irrigation project has been formed in Maverick county, looking to the construction of a canal leading out from the north bank of the Rio Grande, some thirty miles above Eagle Pass, and extending down the river for twenty-five miles.

The San Antonio Irrigation Co. has been incorporated to build a canal 25

miles long and 14 feet wide to irrigate 25,000 acres of land; Z. O. Stocker, San Antonio; J. S. Taylor, Laredo, Tex.

UTAH.

The Pioneer Electric Power Company, of Ogden, has commenced the construction of its irrigation canal, lying west and northwest of Ogden and on the north side of the Weber river. The canal will have a capacity of 120 cubic feet per second, and is intended for the irrigation of 18,000 acres of land.

Two companies are clawing at each other in the effort to first acquire possession of rights on the Gooseberry reservoir and irrigation scheme near Mt. Pleasant, Utah, a new Richmond, with a surveying corps, having lately appeared upon the scene. This reservoir scheme is, with the exception of the Bear River Irrigation Company's, the largest and most important in Utah, and will involve an outlay of a capital of \$500,000.

Henry M. Ryan, representing a company of Chicago capitalists, will shortly begin the greatest undertaking ever yet attempted for the development of the mines in the Camp Floyd district—that is, a thorough prospecting of the district by means of diamond and churn drills.

WASHINGTON.

A very large irrigation project is talked of in the State of Washington. The plan is to tap with a main canal the St. Joe river, in Idaho, and carry the water across the fertile portion of eastern Washington to the arid region of the Columbia basin, and reclaim two or three million acres of land which is at present valueless except for scanty grazing.

A Seattle syndicate has shipped to the Everett smelter, from one of a group of mines owned by the syndicate, a carload of ore which turned out a value of \$70.96 per ton in gold, silver and lead. The vein was discovered early in August and has been traced on the surface for more than 1,400 feet. The mines are located eight miles from Skykomish Station on the Great Northern.

Spokane is feeling the good effects of the revival of mining in the Trail Creek and other districts. During the past year over \$250,000 has been paid out in Spokane in dividends, one mine, the War

Eagle, alone paying \$132,000. The Le Roi has paid \$25,000, the Slocan Star \$50,000, and the Cariboo claims large amounts.

The great jetty at the mouth of the Columbia is nearing completion. The jetty is one of the most successful works of the kind ever constructed, and the cost has been far within the estimates. There is now a wide, straight channel 30 feet in depth.

An irrigating canal is to be constructed near Walla Walla, which will water 16,000 acres of land.

WYOMING.

Application has been made to the State Engineer at Cheyenne by the Wyoming Irrigation and Land Company for water to irrigate 21,000 acres of land. It intends taking the water from Green river, in Sweetwater county, where this company has secured 48,000 acres of railroad land and has applied for an equal acreage under the Carey act.

A. M. Crafts, the Douglas civil engineer, is in Casper again viewing the territory there, with the intention of carrying successfully his plan of building an irrigating ditch from Bessemer through the hills south of Casper to Glenrock.

A section of country that is attracting more than ordinary attention just now is the Four Mile placers, situated about seventy-five miles south of Rawlins on the Snake river, in Carbon county.

Six thousand five hundred acres of oil lands adjoining the Cudahy tract passed into the hands of C. B. McClenny, of Florida, last week, says the Douglas News.

The Golden Bar Steam Dredging Company intend placing two large steam dredges on the upper Snake river, in Uinta county, for the purpose of working their valuable placer ground, which consists of over 1,000 acres of low bars on both sides of the river.

WASHINGTON, IDAHO, OREGON AND BRITISH COLUMBIA.

The Northwest Fruit Growers' Association held their annual session at Walla Walla, continuing for four days, with extra conclaves in the evening. It was largely attended. Dr. N. G. Blalock, the president, was in the chair, C. A. Tonneson, of Tacoma, acted as secretary.

Hon. H. S. Blandford, in behalf of the citizens of Walla Walla, very cordially welcomed the fruit growers and visitors to the hospitality of the city. There were instructive papers and addresses by N. G. Blalock, J. A. Balmer, E. F. Babcock, J. B. Holt, C. L. Whitney, J. M. Hixson, T. R. Coon, C. A. Tonneson, S. A. Clarke, John Hill, Frank Lee, William Brown, H. S. Blandford, F. I. Whitney, J. P. McMinn, Prof. G. A. Droll, Prof. J. M. Bloss (Oregon Agricultural College) and M. P. Carter and J. R. Anderson (British Columbia). Provision was made for the establishment of a Bureau of Information, the condition for membership to be actual shippers of fruit of Oregon, Washington, Idaho and British Columbia, and also the applicant to be a member of the Northwest Fruit Growers' Association. The standing committee on Bureau of Information was instructed to take up the matter of exposing dishonest commission merchants. The association elected the following officers for the ensuing year: President, Dr. N. G. Blalock; secretary, C. A. Tonneson, Tacoma; treasurer, W. S. Offner; vice-president for Oregon, Emile Schanno, The Dalles; vice-president for Washington, R. C. McCroskey, Garfield; vice-president for Idaho, H. A. Russell, Kendrick. The next meeting will be held at North Yakima, the second Tuesday in December, 1896.

BOOKS AND MAGAZINES.

The December Century has a seasonable Christmas article in Edith Cane's paper on Tissot's *The Life of Christ*, and the first paper on *The Passion Play at Vorder Thierese*, by Annie S. Peck. *The Life of Napoleon* is continued. Among the table of contents are *Appeals to Lincoln's Clemency*; *One Way Out*, and *Humperdinck's Hansel and Gretel*.

One of the leading articles in Scribner's for the month is *Wild Beasts as They Live*, by Capt. Melliss.

One of the most striking contributions is the opening paper by Cosmo Monkhouse, on *Laurens Alma-Tadema*, which is fully illustrated with reproductions of the artist's most famous paintings. There are good short stories by Frank R. Stockton, Joel Chandler Harris, Henry Van Dyke, Charles E. Carryl and A. S. Pier.

The December number of McClure's magazine contains a continuation of the *Life of Lincoln*, with new portraits. McClure's magazine claims to have increased its circulation to the extent of 100,000 since beginning the publication of Lincoln's life. It certainly is one of the most readable magazines issued. Among the other features in this number are: *The Sun's Heat*, by Sir Robert Ball; *Through the Dardanelles*, by Cy Warman, and the true story of Annie Laurie.

Lippincott's magazine for December contains, *English Medieval Life*; *Gunning for Gobblers*; *Orchids*; *Japanese Sword Lore*; *Athletic Sports of Ancient Days and Meets*.

The Christmas Cosmopolitan appears with a colored lithographic frontispiece. Among the leading features are: *A Christmas Legend of King Arthur's Country*; one of Robert Louis Stevenson's stories, *A Tragedy of the Great North Road*; *Butterflies*, by James Lane Allen, and a story called *Tonia*, by Ouida; *Game Fishing in the Pacific*, and *Actresses who became Heiresses*.

The Review of Reviews for December is larger than usual and it is well filled with many important matters. Sherman's Story of his own Career, by E. B. Andrews is interesting. The Venezuelan question is very timely on account of recent developments in the status of affairs between the United States and England. Among the other worthy features are: *An Indian on the Problems of his Race*, and a character sketch of Herbert Spencer. Dr. Shaw in the Progress of the World carefully reviews existing political situations and important current topics.

The Social Economist of New York, edited by George Gunton, for December contains a number of interesting items, among them are: *What Shall be Done With the Tariff*; *Legal Merits of the Venezuela Case*; *Woman Labor in England*, and others.

The Monthly Illustrator and Home and Country for December contains an article of the *Life of Christ*, which is illustrated with innumerable reproductions of celebrated paintings and drawings. The story of Jean Valjean is concluded in this number. This magazine is rapidly taking its place in the front rank of illustrated publications.

LIST OF IRRIGATION REPORTS.

THE following list gives the titles of the principal reports bearing more or less directly upon irrigation which have been printed at the Government Office at Washington, D. C. Some of these are very elaborate and expensive, being fully illustrated by colored maps and diagrams. Nearly all can be obtained either through members of Congress or by purchase from the Superintendent of Documents of the Department of the Interior, Washington, D. C., at cost of printing; or, these two sources failing, they can be had from dealers in Government publications. These reports have been arranged in chronological order, the full title being accompanied by a brief note as to the contents:

1879

Report on the Lands of the Arid Regions of the United States, with a more detailed account of the lands of Utah, with map, by J. W. Powell. 2d ed., 1879, quarto, 195 pp.

United States Geographical and Geological Survey of the Rocky Mountain region. Contains chapters on water supply and irrigable lands of the Salt Lake drainage system, by G. K. Gilbert; irrigable lands in the valley of the Sevier River, by Capt. C. E. Dutton; irrigable lands in that portion of Utah drained by the Colorado River and its tributaries, by A. H. Thompson.

1882

Artesian Wells upon the Great Plains, being the report of a geological commission appointed to examine a portion of the great plains east of the Rocky mountains and report upon the localities deemed most favorable for making experimental borings, by C. A. White and Samuel Aughey. 1882, octavo, 88 pp.

This report is a brief description of the geology of Eastern Colorado and is accompanied by appendices containing details of deep borings at various localities.

Report on the climate and agricultural features and the agricultural practice and needs of the arid regions of the Pacific slope, with notes on Arizona and New Mexico, made under the direction of the Commissioner of Agriculture, by E. W. Hilgard, T. C. Jones, and R. W. Furnas, 1882, octavo, 182 pp.

This pamphlet contains papers upon the climates of the Pacific Slope, the irrigation of the arid region, the soils of the arid region, the effects of alkali, lake and river waters of the great valley and their quality for irrigation purposes, the field crops and animal industries of the Pacific Coast, miscellaneous field culture and other agricultural and horticultural matter, together with a brief description of Arizona and New Mexico.

Report of an examination of the Upper Columbia river and the territory in its vicinity, in September and October, 1881, to determine its navigability and adaptability to steamboat transportation, made under direction of the Commanding General of the Department of the Columbia, By Lieut. Thomas W. Symons, 1882, quarto, 133. pp. 47th Congress. 1st Session, Senate Ex. Doc. No. 186.

This report contains numerous maps and illustrations and describes the Columbia River and its tributaries, as well as the adjacent agricultural areas in Washington.

1887

Irrigation in the United States. A report prepared by Richard J. Hinton, under the direction of the Commissioner of Agriculture. 1887, octavo, 240 pp. 49th Congress, 2d Session, Senate Mis. Doc. No. 15.

This report relates to irrigation in the United States, its extent and methods, with a digest of laws governing water supply, the details being arranged in general by States and Territories.

1888

Report on the interior wheat lands of Oregon and Washington, by Lieut. Frank Greene, 1888, octavo, 25 pp. United States Signal Service.

Letter to the Honorable Secretary of State on the general outline for a proposed scheme for an international dam and water storage in the Rio Grande river near El Paso, Texas, for the control of the annual floods, etc., and preservation of the national boundary to the gulf, and for other purposes.

1889

Annual report of the Commissioner of Agriculture for 1888.

Contains a paper on forest influences, pp. 602-618, by B. E. Fernow.

Report on the Internal Commerce in the United States for the fiscal year 1889, Bureau of Statistics, Treasury Department, 1889, octavo, 697 pp.

Contains description of conditions of agriculture and necessities for irrigation in New Mexico Wyoming and other portions of the West.

Irrigation in Egypt, by J. Barois, Paris, 1887, translated from the French by Major A. M. Miller, Corps of Engineers, U. S. A., 1889, quarto, 111 pp. 50th Congress, 2d Session. House of Representatives, Mis. Doc. No. 134.

This report is illustrated by twenty-two plates and gives detailed information concerning Egypt and the Nile, a description of the irrigation works of Upper and Lower Egypt, methods of elevating and using water, and references to laws and regulations.

Report on rainfall in Washington Territory Oregon, California, Idaho, Nevada, Utah, Arizona, Colorado, Wyoming, New Mexico, Indian Territory and Texas, for from two to forty years, 1889, quarto, 111 pp. 50th Congress, 1st Session, Senate Ex. Doc. No. 91.

This report is illustrated by fifteen maps showing the mean monthly and annual rainfall. It consists of a paper upon the rainfall of the Pacific Slope and the Western States and Territories, by Gen. A. W. Greeley, together with charts and tables of the rainfall on the Pacific Slope with a discussion of the causes of the wet and dry seasons, the abundance and deficiency in different portions, the summer rainy season in Arizona, etc. by Lieut. W. A. Glassford.

1890.

The Climate of Oregon and Washington Territory, 1889, quarto, 37 pp. 50th Congress, 1st Session, Senate Ex. Doc. No. 282.

This pamphlet consists mainly of tables showing the monthly and annual precipitation and also the mean monthly and annual temperatures at points in

Oregon and Washington up to 1887. It is illustrated by 7 maps and diagrams.

Report of the Secretary of Agriculture for 1889.

This report contains, pages 297-300, a paper by B. E. Fernow upon the influence of forests on water supplies.

Report of the Secretary of Agriculture for 1890.

This report contains paper, pp. 227-237, by B. E. Fernow, upon artificial rainfall.

First Annual Report of the United States Irrigation Survey, 1890, octavo, 123 pp.

This is printed as Part II, Irrigation, of the 10th annual report of the Director of the United States Geological Survey, 1888-89. It contains a statement of the origin of the Irrigation Survey, a preliminary report on the organization and prosecution of the survey of the arid lands for purposes of irrigation and report of work done during 1890.

Climate of Nebraska, particularly in reference to the temperature and rainfall and their influence upon the agricultural interests of the State, 5 appendices, and 12 charts, 1890, quarto, 60 pp. 51st Congress, 1st Session, Senate Ex. Doc. No. 115.

This pamphlet consists of a paper upon the climate of Nebraska accompanied by tables giving the monthly and annual precipitation and the mean monthly and annual temperatures.

A report on the preliminary investigation to determine the proper location of artesian wells within the area of the 97th meridian and east of the foothills of the Rocky mountains, 1890, octavo, 398 pp. 51st Congress, 1st Session, Senate Ex. Doc. No. 222.

Consists of a report of the special agent in charge concerning existing artesian wells, accompanied by papers relating to the geology of North and South Dakota, Nebraska, Eastern Colorado, Kansas and Texas. Illustrated by 3 folded maps.

Report of the special committee of the United States Senate on the irrigation and reclamation of arid lands. Report of the committee and views of the minority, 1890, 4 vols., octavo. 51st Congress, 1st Session, Senate Report No. 928.

This consists of a majority and minority report accompanied by the testimony in full and documents presented to the committee during its trip through the arid regions. The first volume treats of the Northwest, including South Dakota, North Dakota, Montana, Eastern Washington, Eastern Oregon and Idaho, and contains 469 pp; the second volume covers the Great Basin regions and California, including Utah, Nevada, California and Arizona, and consists of 573 pp.; the third volume relates to the Rocky Mountain region and Great Plains, including El Paso and Lower Rio Grande, New Mexico, the staked plains of Texas, Western Kansas, Colorado, Wyoming, and Eastern Nebraska, containing 608 pp; the fourth volume contains statements by Major J. W. Powell and other officers in the United States Geological Survey, reports of the United States Consuls in countries using irrigation, and other papers.

1891.

Progress Report on Irrigation in the United States, 1891, octavo, 2 vols., 337 pp., 14 pp. and 10 maps. 51st Congress, 2d Session, Senate Ex. Doc. No. 53.

The first volume contains various papers upon the condition of irrigation in different localities, the climate, wells, and other sources of water supply, irrigation statistics and progress in Colorado, alkali and soil waters in California, and other papers; the second part consists of a description of level lines run across portions of Colorado, Nebraska and Kansas, and is illustrated by profiles showing the depth of water in wells.

Second Annual Report of the United States Irrigation Survey, 1891, octavo, 395 pp.

This is published as Part II, Irrigation, of the eleventh annual report of the Director of the United States Geological Survey, 1889-90. It contains a description of the hydrography of the arid region and of the engineering operations carried on by the Irrigation Survey during 1890, also the statement of the Director of the Geological Survey to the House Committee on Irrigation and other papers, including a bibliography of irrigation literature. It is illustrated by 29 plates and 4 figures.

Third Annual Report of the United States Irrigation Survey, 1891, octavo, 576 pp.

This is printed as Part II of the twelfth annual report of the Director of the United States Geological Survey, 1890-91. It contains a report upon the location and survey of reservoir sites during the fiscal year ending June 30, 1891, by A. H. Thompson; hydrography of the arid regions, by F. H. Newell; irrigation in India, by Herbert M. Wilson. It is illustrated by 33 plates and 190 figures.

Dictionary of Altitudes in the United States, by Henry Gannett, 2d ed. Bulletin No. 76 of the United States Geological Survey, 1891, octavo, 393 pp.

This dictionary gives the altitudes at various points in the United States, including localities in the arid and semi-arid regions.

Bulletins of the Eleventh Census of the United States upon Irrigation, prepared by F. H. Newell. Quarto.

No. 35,	Irrigation in Arizona,	8 pp.
" 60,	" " New Mexico,	14 pp.
" 85,	" " Utah,	23 pp.
" 107,	" " Wyoming,	15 pp.
" 153,	" " Montana,	32 pp.
" 157,	" " Idaho,	26 pp.
" 163,	" " Nevada,	24 pp.
" 178,	" " Oregon,	26 pp.
" 193,	Artesian Wells for Irrigation,	27 pp.
" 198,	Irrigation in Washington,	17 pp.

Report on the Internal Commerce of the United States for the year 1890. Treasury Department 1891, octavo, 1174 pp.

This volume contains reports upon the condition of agriculture and of irrigation in Arizona, California, Idaho, Nevada, Oregon, Utah, and Washington, in connection with statistics relating to the commercial interests of these States and Territories.

Canals and Irrigation in Foreign Countries. Reports from the Consuls of the United States in answer to circulars from the Department of State, 1891, octavo.

This report consists of descriptions of navigation and other canals in various foreign countries, and of irrigation on the continents of Africa, America, Asia, Europe, also in Australasia and the Hawaiian Islands.

Irrigation and Water Storage in the Arid Regions. A report of the Chief Signal Officer of the Army in response to House resolution dated May 23, 1890, relating to irrigation and water storage in the arid regions, 1891, quarto, 356 pp. 37 maps. 51st Congress, 2d Session, House of Representatives Ex. Doc. No. 287.

This volume consists of a report on the climatology of the arid regions of the United States with reference to irrigation by Gen. A. W. Greeley, and is accompanied by numerous diagrams and tables showing the monthly and annual precipitation at stations in Arizona, New Mexico, California, Nevada, Colorado and Utah. It is also accompanied by a report upon the climate of Arizona with particular reference to the rainfall and temperature and their influence upon the irrigation problems of the territory. Also a similar report upon the climate of New Mexico and California and Nevada.

1892

Report of the Secretary of Agriculture for 1891, octavo, 652 pp.

Contains, pp. 191-229, report of the division of Forestry

With remarks on water management; also, pp. 430-450, report of the artesian and underflow investigation and of the irrigation inquiry.

Irrigation of Western United States, by F. H. Newell, Extra Census Bulletin No. 23, September 9, 1862, quarto, 22 pp.

This report contains tabulations showing the total number, average size, etc. of irrigated holdings, the total area and average size of irrigated farms in the sub-humid regions, the percentage of number of farms irrigated, character of crops, value of irrigated lands, the average cost of irrigation, the investment and profits together with a resume of the water supply and a description of irrigation by artesian wells. It is illustrated by colored maps showing the location and relative extent of the irrigated areas.

The Climatic Conditions of Texas, especially with reference to temperature and rainfall, by Gen. A. W. Greeley, Chief Signal Officer, 1892, quarto, 120 pp. 52nd Congress, 1st Session, Senate Ex. Doc. No. 5.

This report contains a description of the mean annual temperature and the variations therefrom, the cold waves, the precipitation in the form of rain and snow, its distribution throughout the year and its variability, also remarks upon droughts, evaporation, the amount of sunshine, wind movement and other meteorologic details. It is accompanied by tables showing the mean temperatures by months and years, and the monthly and annual precipitation at various localities. These facts are illustrated by numerous maps and diagrams.

1883

Report of the Secretary of Agriculture for 1892, octavo, 656 pp.

Contains, pp. 292-368, report of the Division of Forestry.

1893

Certain Climatic Features of the Two Dakotas, illustrated with 163 different charts and diagrams, by Lieut. John P. Finley, 1893, quarto, 206 pp.

This report contains a description of the physical features of the two Dakotas, the meteorological records, the amount and distribution of rainfall, and its relation to irrigation, the droughts and temperature.

A report on irrigation and the cultivation of the soil thereby, with physical data and progress within the United States for 1891, accompanied by maps, illustrations and papers by Richard J. Hinton, 1893, octavo, four parts. 52nd Congress, 1st Session, Senate Ex. Doc. No. 41.

The first part consists of a general description of the growth of reclamation during 1891, the work on the great plains, and the results, the physical conditions in various States and Territories, and a number of papers by various authors upon different phases of irrigation. It contains 459 pp. with numerous illustrations. The second part consists of the final report of the Chief Engineer, Edwin S. Nettleton, with maps, profiles, diagrams and additional papers, the principal portion being a report by W. W. Fullett, Assistant Engineer, upon a line of levels run in the vicinity of Cheyenne, Wyoming; Sterling, Nebraska, the Frenchman River, Big Springs, North Platte, Lexington, Loup River, and Grand Island, Nebraska, Garden City, Dodge City, and Great Bend, Kansas. The third part consists of the final geological report of the artesian and underflow investigation between the ninety-seventh meridian of longitude and the foothills of the Rocky mountains, by Robert Hay; the principal paper in this part is that by Robert T. Hill upon the geology of Texas. The fourth part consists of the final report of the mid-plains division of the artesian and underflow investigation. This whole report consists of a revision of Senate Ex. Doc. No. 222, 51st Congress, 1st Session, noted above.

The Thirteenth Annual Report of the United States Geological Survey, 1891-92. Part III. Irrigation, 1893, octavo, 486 pp.

This report consists of three papers, the first upon

Water Supply for Irrigation, by F. H. Newell; the second on American Engineering and upon Engineering Results of the Irrigation Survey, by Herbert M. Wilson; and the third upon the Construction of Topographic Maps and the Selection and Survey of Reservoir Sites, by A. H. Thompson. It is illustrated by seventy-seven plates and 119 figures.

A Geological Reconnaissance in Central Washington, by Israel Cook Russell, 1893, octavo, 106 pp. fifteen plates, Bulletin No. 108 of the United States Geological Survey, price fifteen cents.

Contains a description of the examination of the geologic structure in and adjacent to the drainage basin of Yakima River and the great plains of the Colorado to the east of this area, with especial reference to the occurrence of artesian waters.

1894

Report on Agriculture by Irrigation in the Western Part of the United States at the Eleventh Census, 1890, by F. H. Newell, 804, quarto, 283 pp.

This report consists of a general description of the condition of irrigation in the United States, the area irrigated, cost of works, their value and profits. It also describes the water supply, the value of water, artesian wells, reservoirs and other details; it then takes up each State and Territory in order, giving a general description of the condition of agriculture by irrigation, and discusses the physical condition and local peculiarities in each country.

Fourteenth Annual Report of the United States Geological Survey, 1892-93, in two parts. Part II. Accompanying papers, 1894, octavo, 597 pp.

This report contains a paper upon Portable Waters of the Eastern United States, by W. J. McGee; Natural Mineral Waters of the United States, by A. C. Peale; Results of Stream Measurements, by F. H. Newell, illustrated by maps and diagrams.

A Geologic Reconnaissance of Northwest Washington, by George H. Eldridge, 1894, octavo, 72 pp. Bulletin No. 119 of the Geological Survey, price ten cents.

Contains description of the geologic structure of portions of the Big Horn Range and basin, especially with preference to the coal fields, and with remarks upon the water supply and agricultural possibilities.

1895

Year-book of the United States Department of Agriculture, for 1894, quarto, 608 pp.

Contains, pp. 155-176, Water as a factor in the growth of Plants, by B. T. Galloway and A. F. Woods; pp. 461-500, Forestry for Farmers, by B. E. Fernow.

Sixteenth Annual Report of the United States Geological Survey, 1894-95, Part II.

Contains a paper upon the Public Lands and their Water Supply, by F. H. Newell, illustrated by a large map showing the relative extent and location of the vacant public lands.

Annual Report of the Commissioners of Indian affairs, 1894, octavo, 1034 pp.

Contains description of irrigation ditches and works upon various Indian reservations.

Report of Progress of the Division of Hydrography for the calendar years 1893 and 1894, by F. H. Newell, 1894, octavo, 176 pp. Bulletin No. 131 of United States Geological Survey.

Contains results of stream measurements at various points mainly within the arid region and records of wells in a number of counties in Western Nebraska, western Kansas, and Eastern Colorado.

POINTS FOR FARMERS

DR. T. J. Dodge, of Illinois, has a recipe for hog cholera which he says he has used for thirty-five years with great success. He says he has experimented by placing one well hog with a lot of sick ones, and keeping it well by the use of this remedy. The doctor says he regards it his duty to make the remedy known, and recently in an exchange he gave the prescription as follows:

Arsenic, $\frac{1}{4}$ lb; cape aloes, $\frac{1}{4}$ lb; blue vitriol, $\frac{1}{4}$ lb; black antimony, one ounce. Grind and mix well the remedy before using.

The following are the directions for using:

1. Sick hogs, in all cases, to be separated from the well ones, and placed in dry pens, with only 5 large hogs or 8 small ones in each pen.

2. Feed nothing but dry food, but no water, only the slop containing the remedy, until cured.

3. When the hogs refuse to eat, turn them on their backs, and then, with a long-handled spoon put the dry medicine down their throats.

4. Dose for large hog: One teaspoonful three times a day for three days; then miss one day, and repeat amount until cured. Shoats and pigs, half the amount.

5. As a preventive, one teaspoonful once a week will keep your hogs in a healthy condition to take on fat.

Every Farmer is to a great extent a manufacturer and ought to keep a record of his operations. This is the key to success in any business. But the soil-tiller should attend to some other matters in connection with his accounts. A writer in an exchange suggests the map of the farm, with each field numbered, and its size, quality of soil, etc., specified, will be a great aid in keeping track of the year's transactions. How many farmers have such a guide and convenience? And how many kept such a memorandum the past year as will enable them to tell the expense of each crop grown? And

how about the domestic animals? If you keep cows, what have they paid you per head in the aggregate? And what of sheep, swine, and even chickens? How much did each contribute to your income, and which was the most profitable?

Timber Strips.—Many attempts at tree planting on the Western plains have met with poor success because they have been improperly conducted. The aridity of the climate requires that suitable varieties be selected and properly combined; that a sufficient mass of foliage be obtained to create favorable conditions of growth, and then that the trees should not be left to themselves, but should be as thoroughly cultivated as any crop of corn. Sufficient experience has now been attained to demonstrate that when these conditions are observed timber strips can be successfully grown.

The New Celery Culture is the result of intensive gardening. It means larger and better yields from the same area. The new culture for celery consists of a system of close planting by which a part at least of the stalks can blanch in the shade of their own foliage. Rich soil, irrigation, and proper mechanical conditions of the surrounding earth are presupposed. Plants are set about five inches apart and the rows ten inches apart. Very rich soil is required and plenty of water for best results.

Preparing the Poultry.—Turkeys dry picked sell best and command better prices than scalded lots; the appearance is more attractive. Ducks and geese should be scalded in water as near the boiling point as possible, and it requires more time for the water to penetrate the feathers than those of other fowls. Leave the feathers on the head, and for two or three inches on the neck. Do not singe the bodies as the heat will give them an oily and unsightly appearance. After picking, hold in scalding water a few

seconds for the purpose of plumping, then rinse with cold water.

For Keeping Fruit.—The following rules for keeping fruit in winter are given in the Albany Cultivator: First, keep the temperature within a few degrees of the freezing point. Second, let it be as uniform as possible, as an occasional warm draught hastens decay. Third, exclude air currents not required to maintain ventilation and uniform cold. Fourth, keep all odors away from the fruit.

Try Sulphur.—No more effectual general agent for the destruction of disease germs has been discovered than sulphur. This fed to hogs does not always make them proof against the attacks of cholera, but its efficacy has proven so great in many cases that some of those who have used it consider it a sure preventive. The best form to administer is in the hard lumps, which hogs eat readily and without wasting it.

Feeding Turnips to milch cows is objected to by some on the grounds that the turnips taint the milk, contain too much water, and are not economical. Turnips have always been fed to cows in New England as well as the European countries and regarded as a good feed. The prejudice probably arises from not understanding that turnips should be fed after milking and not before.

Good Demand.—Two carloads of celery were recently shipped from Ogden, Utah, one to Kansas City, the other to Chicago. These are the first full car loads shipped out of Utah. Some Denver gardeners have shipped celery as far East as New York and Boston, but the lots were not large and were sent by express. One firm near Denver has a standing order from a large hotel in New York City for celery shipped daily by express.

Corn as a Pork-Maker.—It is generally believed that a bushel of corn will make ten pounds of pork. If this were true it would be much better for the farmers to feed their corn to hogs than sell it at present prices. Whether a bushel of corn is good for ten pounds of

pork or not depends largely on circumstances, and especially on the previous treatment of the animal itself.

OPENING OF THE CHICAGO MINING BOARD.

The Chicago Mineral and Mining Board will open for business on Monday, January 6, its location being on the banking floor of the great New York Life Building. At a meeting of members Monday, December 30, the following officers were elected: President, John Marder; first vice-president, Joseph Underwood; second vice-president, Charles E. Rollins; treasurer, John Hill, Jr.; secretary, Henry Burkholder; attorney, John M. Palmer.

Standing committees were appointed as follows: Finance, H. W. Treat, J. B. Ream, J. Walter Proby, Morris H. Walker, Edward C. Billings; Arrangements, S. E. Magill, W. H. Underwood, Jr., Edward F. Bogart; Membership, Green B. Raum, C. S. Sawtelle, Robert Connelly, Horace F. Brown, A. H. Nelson, Timothy Cole, E. A. Webster; Arbitration, S. W. Fernald, George S. McKenzie, C. C. Chapin, Peter S. Daly, Peter Dudley; Listing, B. A. Seitz, M. A. Sheridan, R. H. Field, R. L. Martin, C. E. Gates; Statistics and Information, G. A. Downs, H. D. Griffin, Wilson I. Davenny, John Mayo Palmer, C. W. Pomeroy, Otto Gresham, L. A. Davis.

Chicago, New York, Denver, Helena, Salt Lake City, San Francisco, and other towns and cities in the Western mining fields are represented in the membership. Chicago banks have representatives, as also has the Chicago Board of Trade and the Stock Exchange. Total membership thus far, 250. An additional membership of 250 has been voted at \$250 each.

Every precaution is being taken to protect the public against fraud in dealing in mining properties and securities. The rules relating to the listing of mining securities are very rigorous. As is seen, the standing committees are composed of experienced mining men, and they have been given power to appoint auxiliary members who are resident locally in the mining districts of the West.

Besides the precious metals, the Board includes properties bearing iron, coal, lead zinc, tin, copper and all other minerals and metals.

THE EDITOR'S DRAWER

THE people of Illinois are proud of Dr. Charke Gapen, the superintendent, and Messrs. Sill, Orr, Radeke and Granger, the Board of Trustees of the Illinois Eastern Asylum at Kankakee. In proving what irrigation will do for a farm in a State like Illinois those officials have benefited the agriculturists of the country generally.

THE third annual convention of the Nebraska State Irrigation Association was held at Sidney. It was very largely attended and there was immense enthusiasm. The recent decision of the State Supreme Court gave every encouragement. Great progress will be made in irrigation projects during 1896. Speakers were present from all over the country and the benefits of general irrigation were clearly shown.

PLATFORM for 1896: 1—Federation of all agricultural organizations. 2—Smaller farms. 3—Irrigation. 4—Diversified crops. 5—Improved public highways. 6—Uniform, cheap railroad rates. 7—Free rural mail delivery. 8—Let your legislators and Congressmen know what you want.

FREE SILVER was declared for by the Trans-Mississippi Commercial Congress. A great exposition of the products of States west of the Mississippi river was advocated, and resolutions adopted asking the National Congress to make an appropriation in aid of it.

CONFERENCE of the Bi-Metallic Leagues of Great Britain, France and Germany, now going on in Paris, has for its object the drafting of an agreement regarding bi-metallism which will be submitted to the parliaments of the three countries.

IN the National Grange the resolution was stripped of the export bounty clause, and, as adopted, favors protection to farming, and requests Congress to investigate the merits of Lubin's plan.

WITH her mineral and Mining Board, and also a Mining Exchange, Chicago will

be the central point for investors. New York also has a mining exchange.

THE Wisconsin State Grange adopted a series of resolutions urging that "the government should monopolize the issuing of money, and make the volume of legal-tender large enough to supply the wants of the people."

SENATOR CHANDLER'S BILL for the unlimited coinage of gold and silver provides that the law shall take effect when similar laws have been adopted by England, France and Germany. A majority of the Senate favor free silver.

A DECISION as to the constitutionality of the Wright law in California is about due from the United States Supreme Court. This decision will have a direct bearing on the irrigation laws in all the Western States.

IN order to prevent the necessity of further bond issues, revenue for government expenses must be raised by restoring the duties on some commodities, and two of these are wool and woolen goods.

RAILROADS are the great developers, and a big boom in railroad building—actual building—is announced from all the far Western States and Territories.

IF there should be war, wouldn't prices of breadstuffs, meats and horses go booming! A great many people are afraid Great Britain may back out.

ILLINOIS, Wisconsin, Minnesota, Indiana and Ohio have members of the National Irrigation Congress. At the next session every State in the Union will send delegates.

THE Harvey county (Kansas) colony who went to Louisiana three years ago have just arrived back—on foot.

THE American Bi-Metallic League will attend the silver conference at Washington, D. C., the 22d of this month.

WHAT about our own boundary line dispute with Great Britain—that Alaska line?

TOPICS OF THE TIME

The Spread of Irrigation. The arid regions will have to look to their laurels for irrigation. Irrigation is becoming general and no mistake. It was the general drought throughout the country the past season that has awakened the agriculturists of the rain belt. Illinois already has one wonderful irrigated farm and the coming season farmers in various sections of the State will adopt the safe plan for crops. Wisconsin, Iowa and Minnesota will also have irrigated farms, and similar announcements come from Indiana, Ohio, Pennsylvania and other States, while the irrigation operations in the South will be largely increased. It has come to be generally appreciated, that irrigation, with diversification of the crops, is the sure road to prosperity.

Tiding Them Over. A big trust company has just been organized in Chicago, the business of which will be to loan money to cattle ranchers and farmers who are not ready to market their herds or crops. By the aid of this company it is urged that cattle, corn, etc., need not be sacrificed when prices are as at present. Of course the company will make money but its operations will prove most beneficial to people who need to be tided over. Among those at the head of the organization are P. D. Armour, E. A. Cudahy, Herman Kountze, John A. Creighton, J. M. Woolworth, Fred Davis, John A. McShane, W. A. Paxton and several Boston and New York capitalists. The capital is \$1,000,000. Offices of the company will be located at Omaha and Kansas City.

Armies of Immigrants. With the new flood of gold, or the prospect of a new flood of gold, armies of immigrants will take their way to the Western States and Territories in the Spring. From every section of the country co-operative parties and individuals will be leaving. It is likely, too, that inasmuch as the present boom has reached every part of Europe, immigrants to this

country from the Old World will, more generally than usual, be ticketed through to the Western States and Territories. All this being true, Western America might as well prepare to provide for them. If there is not employment in the mines for all of these people, there are irrigation farms—acres sufficient for all. The mining boom has attracted the people generally, as well as the capitalists and investors of this country, but if hosts of poor men, expecting work, reach Colorado and other States and Territories in the winter season and find nothing to do, their plight will be a sad one. And this is just the prospect at present. Poor men from every point are working their way West. It would be a humane act for the State officers of Colorado to publicly notify the working people of the country of the present situation and the chances of employment. Men with a little means can go out West at any season and get along, but it is no poor man's country in the winter time.

West and South. All the efforts of the merchants of Chicago and the West to open up trade with the Southern States having failed, that rich field has for years been almost abandoned, and New York and the East have been the gainers. Spasmodic attempts have been made to solve the mystery as to why the South preferred to trade with New York when it could do better with Chicago, but nothing satisfactory could be ascertained. When the railroad magnates were inquired of, the answer invariably was, "Oh, the Southern States have their trade relations with New York established for years and they will not make any change." But with the Atlanta Exposition, and the mingling of Western farmers, merchants and manufacturers with those of the South, the whole matter is cleared up, and the prospect is that hereafter shipments from the West to the South and vice versa will prove a big factor in the commerce of the country. It is conclusively proven that for years past the railroads, at the instigation of New York and

the East, have been discriminating against the West. A strong alliance is being formed between the West and South for the building up of cotton manufactures in the South in competition with New England, and Chicago is to hold a great exposition of cotton and Southern cotton manufactures. It is not impossible that the West and South may act together on various questions, one of these being silver.

Western Farming Lands. The announcement from Springfield, the State capital, says of the incorporation: "The Chicago Mineral and Mining Board, at Chicago; without capital stock; to provide facilities for dealing in ores and securities of corporations engaged in developing mineral deposits; incorporators, Green B. Raum, Joseph Underwood and John Mayo Palmer." Three better known men do not exist in Chicago or in Illinois. Ex-Governor Palmer has a national reputation. This enterprise is a board where parties and companies having mining claims or properties can meet capitalists, and part of the project is the rigid investigation of all properties attempted to be floated. Chicago will also have a Mining Exchange, but this board must not be confounded with it. Western America may well be congratulated that Chicago has taken hold and will aid in the development of the mineral resources, and also the agricultural resources, for Western agricultural lands will be operated in on the Mineral and Mining Board. Now is the time for the Western States and Territories to push their lands into the market. Careful, conservative investors take more readily to agricultural lands than to mining shares, and of the armies of men who go West in the spring to dig gold many must remain to irrigate. It must be remembered, too, that the big new population in the mining camps must be fed and that grain, vegetables and fruit and cattle and hogs and mutton are necessary to feed them with. That 1896 will witness great strides in the development of the West is a foregone conclusion.

Wool and Lumber. The rank injustice of taking the duties off wool and lumber is now generally realized and condemned, and Democrats in the wool and lumber States are loudest in their complaints. A gallant fight has been made to

have duties restored, and if this fight is kept up, it can not fail of success in the present Congress. Revenue must be raised; and the articles that should be taxed are those mentioned. It will be "tariff for revenue only."

For Success. In the present age every class of business—every profession **Organize.** even—is organized. The trades are organized, and even unskilled labor is more or less organized. Business, banking, and railroad and water transportation are organized into immense trusts or pools. Now, in order to obtain their rights, hold their own and advance to prosperity, farmers and stock raisers must more closely organize. This closer organization was advocated at the meeting of the National Grange and it was also advocated at the subsequent meetings of the State Granges of Illinois, Indiana, Michigan, Kansas, Missouri, Nebraska, etc. Every man engaged in farming and stock-raising must be gathered into the fold. With this thorough organization, every question affecting agricultural interests can be regulated; all needed legislation can be secured. At the recent meeting of the Illinois Grange, Mortimer Whitehead, formerly one of "Uncle" Jeremiah Rusk's right hand men, made a ringing address in which he scored the politicians and their methods and urged co-operation among the agriculturists in everything. Governor Altgeld spoke at some length and advised the farmers to organize and look out for their own interests, intimating that if they did not do so they could not expect others to do it for them.

There Is No Ratio. Will the great output of gold bring the ratio of gold and silver together?" ask the great leading editorials in the dailies. Whatever may be said for or against the free coinage of silver, it is a fact that a great deal of the hostility to it comes from the common notion that as things are now there can be any ratio between gold and silver. At present, silver is simply a commodity, the same as copper. Copper is not spoken of as having any ratio to gold simply because a quantity of copper has been taken to make pennies out of, and why should silver be spoken of as having a ratio to gold simply because a quantity of silver has been used to make dollars

out of? How can silver bullion have any relation to gold when silver was demonetized or destroyed as final redemption money? No kind of metal can have any ratio to gold unless it is used as primary money, and then the ratio will be exactly what the law wishes it. There can be but one legal ratio between metals; that one is made by law, and the law of supply and demand will always compel the commercial ratio to be very close to the legal ratio. But now there is no ratio at all in the United States between any kind of metals because there is only one metal made into primary money. Hence, there is unnecessary fear that the commercial ratio between gold and silver, in case of free coinage of silver, would ever vary very much from the legal ratio.

Down the Beef Combine! With the new ruling against bogus butter and the seizure of unbranded oleomargarine at several points, comes more trouble for the Chicago packers. It is understood that the new Grand Jury ordered for the United States District Court in Chicago will bring in indictments against the beef combine. It is known that the information gathered by the special agents of the Department of Justice and the Agricultural Department will be presented to the jury.

Confidence Again Returning. Those bright Northern lights are indications of returning confidence, and sure signs of a new era of prosperity. The lights are from the great blast furnaces of Northern Wisconsin and Michigan. The friends of protection to home industry are again in power at Washington and all the great iron and steel mills will soon be going again under full headway.

Robbing Grain Growers. The Chicago Board of Trade is expelling members and doing all it can to reform itself. The board is unable, however, to get from under the control of the elevator ring, which has absolute sway in the handling and shipping of grain. This ring is an absolute detriment to Chicago and is a bloodsucker to every grain grower in the West. The State legislature should investigate and break up this nefarious combination, but it is afraid. It would be a blessing to the agriculturists of all Western America if the

farmers of Illinois would make a political issue of the elevator abuses in Chicago and elect a legislature pledged to break them up. A majority of the members of the Board of Trade would gladly render their assistance. The Illinois State Grange, which has been such a great sufferer, has opened the ball against Chicago methods. At its recent meeting a special committee was authorized to draft a memorial to Congress requesting that stringent legislation be enacted against option dealing—gambling—in grain, and the use of the telephones and telegraphs for that purpose.

THE National Grange and various State Granges demand that Secretary Morton be retired and that "a man be chosen from the ranks of the farmers, with a knowledge of agriculture." Farmers strongly approve the rebuke given to Mr. Bayard, the Minister to England.

COMMISSIONER LAMOREUX urges the necessity of a national commission to regulate the distribution of irrigation waters in the West.

THAT fraud, oleomargarine, can not masquerade any longer as butter under the name "butterine." It must be stamped "Oleomargarine."

THE Illinois and Michigan State Granges declared for the remonetization of silver, and against the retirement of the greenbacks.

NO way of successfully fighting the sugar and oil trusts, and the beef combine has yet been discovered or invented.

A GOOD ROAD is being built from Chicago along the lake shore through Kenosha and Racine to Milwaukee.

THE Western States are to have possession of their grants of arid lands before the lands are irrigated.

AN irrigation plant and a mortgage never remain long together on the same farm.

CHICAGO permits the sale of horse meat for food.

THE Chicago Metal Reduction Company has increased its capital stock.

THE sugar bounties are to be paid.

THE SILVER ELEMENT SHOWS ITS TEETH.

The revenue bill passed the House by 205 to 81, some Democrats voting with the Republicans in favor of the measure. As passed, the bill repeals the present tariff law until August 1, 1898. It restores 60 per cent of the McKinley rates on wool and woolens, lumber and carpets, and makes a horizontal increase of the present rates in all other schedules, except sugar, of 15 per cent. The House passed the Republican (gold) bond bill by 169 to 136. It was on this bill that the silver element showed its strength and its disposition. Democrats and Populists voted solidly against the measure, and were aided by forty-seven Republicans, several of them from the South and all the others from the West and Northwest. The President and Secretary Carlisle of course fight both these bills. Silver rules the Senate and the bond bill stands little chance there, but men like Senator Thurston of Nebraska are of the opinion that, after lengthy debate, the revenue bill will pass. If it does, the President may allow it to become a law without his signature.

In advance of anything Congress may attempt in regard to the gold bond bill, the President has decided to issue \$100,000,000 more 4 per cent thirty-year bonds.

ANOTHER CHICAGO REDUCTION COMPANY.

Certificates of organization has just been issued to the American Reduction Company, at Chicago; capital stock, \$150,000; to mine, smelt and reduce ores. The incorporators are Walter J. Doere, J. A. Pollock and S. S. Willard.

A CRISIS IN THE INTERSTATE COMMERCE LAW.

The Interstate Commerce law is approaching a crisis. The case filed in New York against the Joint Traffic Association will make it or break it. The Government will do its utmost to sustain the law. Thirty railway companies owning and operating nearly 31,000 miles of road and capitalized at \$1,000,000,000, are combined against it. The Government is by no means certain of success. Much depends upon a decision in what is called the Brown case, to be made early this month in the United States Supreme

Court. This decision will determine for good the right of the Commission to compel railway men and shippers to testify. If the Brown case is lost the Interstate Commerce act is lost and the Commission is lost with it.

AFTER THE BEEF COMBINE.

Kenesaw M. Landis, formerly private secretary to Secretary Gresham, has been appointed a special assistant United States attorney for the Northern District of Illinois to appear in behalf of the Government in the prosecution of the beef combine among Chicago packers. His duty will be to direct the investigation now in progress. When Secretary Morton was in Chicago some time ago he expressed a desire to proceed with more rapidity in the investigation. He had several conferences with the men employed to secure evidence. Col. L. Monroe Haskell, of the Department of Justice, and Edward Sheldon, of the Agricultural Department, have been in Chicago for a long time looking into the charges against the combine, and have made frequent trips out of the city. Mr. Landis will, as Gen. Black's assistant, look after the legal end of the work. A great mass of convincing evidence will be presented to the Grand Jury which has been called for January 14. A large number of cattle men from all over the West will be present and testify before the Grand Jury. The packers have retained able counsel and will make a hot contest.

GETTING THEIR LANDS BACK.

Judge Randolph, in the District Court at Emporia, Kan., has decided that a deed cannot be given after foreclosure and sale by the sheriff, and instead ordered a simple certificate of purchase. The plaintiff will take the case to the Supreme Court. This decision will save to the citizens of Lyons, Chase and Coffey counties alone over half a million dollars, as it means that in a majority of the cases which have been foreclosed and embraced under this act the debtor may pay into court the price at which the land was bid in, together with the interest, cost and taxes, and get the land clear.

MACHINERY AND APPLIANCES

IRRIGATION is no longer confined to the arid regions. Farmers generally in Illinois and throughout the Central States, and in the East and South are going into irrigation. With this change comes a great demand for irrigating machinery and devices, but improvements are demanded and inventors who can produce the necessary machinery at cheaper prices than rule at present have a great field before them. Whether wind, steam or electricity, or all of them, are used, the great necessity is less expense. Past experience, very recent and very bitter, has demonstrated that the age of prayer for rain must be relegated to the rear. Farmers with fine holdings in the most fertile States of the Union, with great water courses near them, are tired of getting only part of one crop a season after a hard season's work and anxiety, when during the same season, under the same and much worse conditions, the farmers on arid lands and much smaller holdings, turn out several bountiful crops. They, too, will irrigate, for, with what has been considered plenty of rain, an irrigated farm in Illinois, or any other State, will bear four-fold greater than a farm that is not irrigated. Irrigation is found to be superior to the natural rainfall!

The drift of the times is toward general improvement in farming, and irrigation of the land and diversification of crops are at hand. In the future, too, the farms will be smaller, every inch will be worked, and nothing neglected. Methods will be changed, implements improved, and skill employed in packing and distribution. Farming has not kept pace with any other industry that can be mentioned. The thorough organization among the agricultural classes will aid them to advance—is already aiding them. A former well-to-do farmer residing near Springfield voiced a general sentiment at a meeting recently when he said: "I was actually thinking, after all these years, of leaving dear old Illinois for the South. But no. I will remain here and employ advanced methods. Irrigation is

a success on arid lands. They resort to it, indeed, in the South. Now I am going to irrigate right here. If improved and cheaper pumping plants are offered, well and good, but I won't wait for them. In farming, I am going to keep abreast the times hereafter, just as other industries do."

As to the means to be employed for irrigation in Illinois and other Central States, they will be various. Lands near streams will of course obtain their water by pipelines, while in other sections there will be wells and reservoirs, and various modes of power will be employed, the cheapest and best of course becoming the most popular. There will be gas engines and oil engines, and the wind-mill, too. It is promised, indeed, that some electrical surprises will be sprung at an early day.

There are suggestions for new beginners in the reports from Kansas, where the people are enthusiastic for the safe plan of farming. The number of farmers irrigating in Kansas for the first time in 1888 was 26; first time in '89, 13; first time in '90, 28; first time in '91, 18; first time in '92, 33; first time in '93, 55; first time in '94, 224; first time in '95, 1,241. The total number of irrigators in 1895 was 1,638. It is seen that the growth of the industry was most rapid. And Kansas is the State that Governor Morrill and Mr. Burton boast of now as "the garden spot of the West." The depth of their wells varies all the way from 10 feet to 240 feet, the average money cost of windmill plants, not including any labor by proprietor, \$118; of steam plants, \$293; of gasoline plants, \$486; of horse power, \$73. These figures are given by the Kansas State Board of Irrigation. Number of answers to the question "Is irrigation by pumping a success?"—affirmatives, 338; negatives, 6. In their neighborhood, the waters of the streams are of course utilized.

Inventors and manufacturers will find it a paying investment to devote some thought to the question of cheaper pumping plants for irrigation purposes.

Electricity is making its way to the farm work at last. In the line of harnessing it for work, a Danish farmer has made a successful experiment of its use for threshing. It is not, however, as a motive power alone that electricity promises to assist the agriculturist. French scientists have been at work experimenting with it as to its influence on growing crops. They have succeeded in hastening the germination of peas, beans and corn by the use of the electric current. Renouncing batteries and powerful engines, which are too expensive and intricate for farmers to use, they have used a new invention called the geomagnetifere, which consists of an ordinary pole forty to fifty feet high, on top of which is insulated a row of copper spikes to collect electricity from the atmosphere. An insulated wire transmits the fluid to a network of galvanized iron wires buried four to six feet under the crops to be experimented on. The electricity seems to act as a powerful fertilizer.

C. M. Palmer, of Fond du Lac, Wis., has received a patent on an improved clipping machine for shearing sheep. The machine is operated by a small electric motor and is said to have increased the capacity.

He's a fine old Irish gentleman,
But he's angry when he's vexed.
He'll buy you drinks one minute,
An' break your face the next.
He's a fine old Irish gentleman -
He's a pal as you can trust:
He's all right when you knows him,
But you's got to know him fust.
—*Minneapolis Journal.*

A MODEL GASOLINE ENGINE.

In Texas a very large number of Weber gasoline engines are in use on ranches and in towns. They operate feed mills and newspaper presses and corn shellers and grinders on feeding ranches as well as having a multiplicity of uses in the towns. In California and Arizona they are used in irrigation plants and to operate hydraulic and other mining machinery. On Kansas farms they shell and grind corn, run threshers and pump water from murky creeks into irrigation ditches. A vast number of them are in use in Louisiana, where they are used on rice plantations and as general farm engines.

The things that recommended gasoline engines are many, among them their great

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TIMES BUILDING, CHICAGO, Feb. 3, 1894.

When members of my family have been benefited by a medicine or treatment we are willing to state the fact for the benefit of others. The Ramey Medicator and treatment for Catarrh and kindred affections we have thus tried. It reaches directly the part affected and the treatment has proved invariably beneficial. Very truly yours, **C. H. HOWARD.**

GOV. CHASE SAYS:

EXECUTIVE DEPT., INDIANAPOLIS, IND., Dec. 22, '92.

I have used your Medicator with entire satisfaction for Colds and Catarrhal trouble. When used according to directions its effect is immediate and a cure seems certain. I shall not travel without it.

Very respectfully, **IRA B. CHASE.**

HAY FEVER. What a Prominent Clergyman says:

CHICAGO, ILL., Jan. 14, 1892.

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I bought one of your Medicators last fall for Catarrh. It benefited me so much; I had lost my hearing, and got it back by the use of your Medicator. Respectfully,
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A Rife Ram at work Irrigating, etc

TABLE OF SIZES AND PRICES.

Engine	No.	Size of Drive Pipe	Size of Delivery Pipe	Gals per Min Required Under 5 to 7 Feet Fall	Re-lated to Use Per Minute	Least Feet of Fall Recommended	Weight	Price, Single-Acting	Price Double Acting
10	1	1	3/4	4 to 5	2 1/2 to 3	5	125	250 00	385 00
15	1 1/4	1 1/4	1	6 " 12	5	3	150	55 00	70 00
20	2	2	1 1/4	8 " 16	7	2	200	60 00	75 00
25	2 1/4	2 1/4	1 1/2	10 " 24	11	2	225	66 00	81 00
30	3	3	1 3/4	18 " 35	15	2	250	75 00	90 00
40	4	4	2	35 " 75	30	2	550	130 00	140 00
80	8 or 10	8 or 10	4 or 5	150 " 350	150	3	3000	450 00	500 00

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(MONTHLY, ILLUSTRATED.)

THE IRRIGATION AGE is a Journal of Western America, recognized throughout the World as the exponent of Irrigation and its kindred industries. It is the pioneer journal of its kind in the world and has no rival in half a continent.

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in Wyoming, which will supply water to reclaim thousands of acres
of land by irrigation.

(See January Issue of THE IRRIGATION AGE for a Full Description).

THE IRRIGATION AGE.

VOL. IX.

CHICAGO, FEBRUARY, 1896.

NO. 2.

THE BROADER SIDE OF THE IRRIGATION MOVEMENT.

BY THOMAS KNIGHT.

WHETHER it be or be not possible to reclaim by irrigation some certain portion of the arid and semi-arid regions of this country is undoubtedly a question of importance *per se*; regarded simply as a local issue there has as yet been no adequate comprehension of the problem by those whose very existence would appear to depend upon its satisfactory solution.

This being the case, it is not surprising that attention to detail and consequent narrowness of the field of observation have, to a great extent, prevented any general recognition of the great principles which, underlying the Irrigation Movement, have given to it most of its influence and all of its vitality. And since the irrigationist insists that not only are these principles true, but will in their application be found to present a means for meeting at least some of the social difficulties of the hour, it is at least reasonable that examination be made of them and the correctness of such a position be discussed.

There are in the world two great economic forces, Labor and Capital. Together they form a prime mover; separately they are impotent. Labor, however, has one advantage in that it is the capital of every man who is able to work, and should at all times be readily convertible into the necessities of life for its possessor.

But it is a lamentable fact that in all civilized nations there is at the present time an inability on the part of labor to effect this conversion, and the tendency

is undoubtedly towards a still greater stringency in the condition. It is manifestly impossible to compel capital to employ labor where the natural demand for such labor is non-existent; what then can be done to enable the laborer to exist, supposing him willing to dispose of his labor but unable to find a purchaser? The irrigationist contends that the necessities of the laborer do in themselves constitute a natural demand which will tax all of his energies to meet, and proposes that he be given the opportunity to satisfy this demand directly, without the competition attendant upon a congested labor market or the evils arising from the fluctuation in values induced by empirical and unstable national legislation.

But labor to be thus utilized must certainly have within its reach such raw material as will absorb it profitably. And it is clear that the ultimate worth of such lies in its capacity to increase in value according to the amount of labor employed upon it. If, in addition, such raw material is capable of not only a cumulative but a recurrent increment, its ultimate worth is incalculable, inasmuch as such cumulative and recurrent properties are practically infinite.

It is in this light that the irrigationist regards the land. As raw material he maintains that, under irrigation, it is capable of making a remunerative return in direct proportion to the amount of labor bestowed upon it. For since the extent of any man's actual necessities depends

not in the least upon the cost of satisfying them, any return which is sufficient to provide these is remunerative, and unless a rise or fall in prices could govern the amount produced from a given area of land by a given amount of labor (which proposition is absurd), it is clear that this return will be both stable and reliable, and thus exactly meet the demand which it is required to satisfy.

That such a result is possible is demonstrated by the facts. The product from an acre of irrigated land under any crop has not yet been even approximately determined, nor does it appear capable of such determination. It is, therefore, a legitimate assumption that while the irrigationist is perfectly safe in his estimate as to the population which may derive support from a given area under conditions favorable to intensive cultivation, it is altogether out of the question for objectors to urge either that the limit of production will soon be reached, or that the available land will be exhausted.

But supposing any such objection were well founded, which it evidently is not, it simply amounts to the proposition that unless our unoccupied lands will absorb the whole of our unemployed labor it is useless to utilize them in the absorption of any part thereof; a position so nearly approaching the ridiculous as to demand no consideration.

Presuming, however, it be conceded possible to fix on the one hand the limit of production, or on the other the extent of cultivable land, it will be at once seen that even this by no means determines the amount of labor provided with employment. The development of the mining districts of the West depends almost entirely upon the ease with which sustenance may be obtained for the labor employed therein. If 100 acres of irrigated land in the neighborhood of such of a district will produce a surplus equal to the support of five men, those five will assuredly set to work upon unoccupied land (other than agricultural) which can now afford no return whatever. And so widespread are these effects that wherever such surplus can be transported at any reasonable cost they are found to operate; without the irrigated fields of Colorado one half at least of her mines would be idle, and all her dependent industries suffer in proportion.

The State of Wyoming today, with her river sands full of gold, her hills rich with mineral, her subterranean shales saturated with oil, waits for what? The intensive cultivation of those fertile acres which will afford not only support to those who till them, but from their surplus maintain the army of workers who shall render these treasures available to the uses of mankind.

Hence it follows that while intensive cultivation means enormously increased returns from the land (and the aim of the irrigation movement is to secure not only larger yields per acre but also extended area under crop), it is by no means a consequence that such a result implies over-production or even any increased competition in the markets; for the bulk of the labor which would derive its direct sustenance from the soil is just that which now is unable to enter the market as a purchaser, while the surplus, as we have seen, would go to supply the demand created for it by the opening of fields for industry which are now non-existent.

If it be true that the real advances in civilization have always been made through its industries, it would therefore appear that the irrigationist will be largely concerned in the transformation which our social life is now undergoing. The possibilities of production from a very small area of land surely point to the massing of population, not in overgrown cities, but in colonies of small holdings, in which all the advantages of urban life may be enjoyed, and many of its evils eliminated. Unless there be any disadvantage to mankind in the exercise of the traits common to humanity which call for social intercourse and intellectual advancement, this tendency cannot be deprecated; the irrigation movement is the outcome of an irresistible demand for the means to meet higher ideas, and its success will be in proportion to its capacity for their satisfaction.

If it be borne in mind that legislation under a popular form of government can never be in advance of social requirements, but must depend upon them for its inception, the necessity for a just comprehension of the broader side of the irrigation movement will be readily conceded. That much of our existing legislation is entirely inadequate to our present social needs admits of no doubt, and it is here that the

irrigationist unflinchingly joins issue with the opponents of the movement. If, as they urge, it is impossible to meet his reasonable demands because existing legislation is adverse, or insufficient, his position is that such legislation must be amended, and by no means that social progression be for a moment retarded thereby.

In order to render such a position tenable, it is undoubtedly necessary for the irrigationist to urge far more than a pure-

ly local or transitory issue. This he squarely claims to be doing, and he estimates his labors solely according to their beneficial results upon the whole commonwealth.

It is from a study of the broader side of the irrigation movement that any just appreciation can be placed upon these; it is from an unprejudiced consideration of its aims by the public, and their unfaltering prosecution by its friends, that success may be expected in their attainment.

WATER SUPPLIES FOR IRRIGATION.*

II. ORIGINAL RESEARCH—RAINFALL AND STREAM DISCHARGE.

By F. C. FINKLE, C. E.

NO irrigation engineer can afford to give a project his unqualified endorsement by basing his examinations and opinions wholly on the data derived from reports made by others, no matter how complete and full such reports may appear.

The most perfect human minds have their failings and are liable to mistakes, and reports, especially those prepared under government supervision, often contain serious errors, inaccuracies and omissions caused by carelessness or a lack of proper interest in the work. The importance of verifying data obtained from other sources than from personal investigation and research is therefore apparent.

It is often the case that no reports, governmental or otherwise, are obtainable, from which any information about the particular locality in question can be drawn. This may be due to one of several causes. The country may be new and unexplored or only partially explored; the data known may be too limited or conflicting to be considered reliable; the region may heretofore have been considered of too little importance to merit investigation at the public expense, or some other cause, known or unknown, may be responsible for the existence of no reports in relation thereto.

In cases of this kind original researches have to be commenced *de novo* and completed before any conclusion can be reached.

We will now endeavor to discuss the methods to be employed and the manner in which the work should be done in order that a perfectly fair, reliable and conservative conclusion may be arrived at.

One of the principal things, and one which requires the most careful and long continued observation to determine, is the rainfall on the watershed tributary to a stream. For the determination of this a pluviometer should be employed on as many different stations on the watershed as possible.

A pluviometer is an instrument for ascertaining the amount of rain which falls from the clouds. It is usually made of brass or some other metal not easily corroded and consists of a cylindrical dish with open top and a long tube connected to its bottom, which is otherwise closed, the tube being of such diameter as to give a sectional area equal to one-tenth of the top area of the dish itself. The edge at the top should be very thin and the measuring rod, for which allowance in proportion to its thickness must be made in proportioning the sectional areas of the dish and tube, should be graduated in inches and tenths of inches. This instrument, when in use, should be set in level, open ground with its top just above the top of the grass and apart from buildings and other obstructions, and the weeds and grass should be kept trimmed below its top. When these conditions are observed

*All rights reserved by the author.

the depths shown on the measuring rod on the tube will be ten times the rainfall in inches.

In places where snow falls, a round dish of equal diameter at top and bottom and of sufficient depth to receive all the snow which may fall in any one storm is used. This dish should be securely set in an open, level place so as to receive all the falling snow due to its area and so as not to allow any snow to drift into it. After each storm the snow should be melted and the obtained depth of water measured, which together with the depth of the snow before melting should be carefully recorded. For accurate gauging the practice of placing the instrument on the roofs of buildings or on other objects elevated above the surface of the ground is to be condemned, as, at any considerable elevation above the ground, the drops of rain in their downward course are deflected in their vertical descent by the force of the wind and less water will enter the rain-gauge than the proportion due to its sectional area. Formulæ which have been suggested for making corrections for different elevations are practically valueless, as so much depends on the relative force of the rain and wind, factors which it is impossible to determine accurately.

In making observations of the rainfall on a watershed, rain-gauges should be placed so as to cover all points where a material difference in the precipitation is likely to occur. The location of the gauges should be correctly determined, so that, when the watershed has been surveyed, the exact points of all observations can be noted on the plat as stations and numbered. A record of each station should be kept showing the date and amount of rainfall each day.

The character of the gathering ground upon which the rain falls has considerable to do with flood discharges from a watershed. The maximum may in some cases reach two-thirds of the amount which actually falls; but this is only to be depended upon when the watershed is small and the surface impervious and barren, and the ground frozen and free from snow. It is impossible to give the maximum discharge with any claim of reliability in the case of large watersheds with loose soil, except where data have been collected in regard to that particular

watershed by actual gauging of the rainfall and measurement of the discharge. Some cases are of record, where the discharge from a large basin with loose ground and slight descent has been so insignificant as to amount to practically nothing.

With zero as a minimum and two-thirds of the total rainfall as the maximum, results vary so much that no ratio can be confidently named even with a good map and description of the watershed at hand. Absolute safety in making estimates of the ratio of discharge for a given rainfall lies in having made a sufficient number of measurements of the flow in the outlet channel to establish a rule applicable to the watershed in question.

In calculating the volume of flood water falling on a given watershed there are three factors to be taken into consideration, *i. e.* (1) Area of watershed. (2) Depth of rainfall and (3) duration of precipitation. By means of these factors we can find the number of cubic feet which have actually fallen from the sky during a flood. But in hydraulics the time as well as quantity are considered so that water is always measured and estimated by the rate of flow in a given space of time, and the units adopted are the cubic foot of water and the second of time, so that the rate of flow is expressed in cubic feet per second.

We now have everything necessary for establishing a formula by which can be determined the rates of a volume of water falling on a known area exposed to an observed precipitation for a given length of time in cubic feet per second.

This formula is expressed as follows:

$$Q = \frac{A \times D}{S}, \text{ in which}$$

Q = Flow in cubic feet per second resulting if all the water falling were discharged uniformly in the same length of time which it has taken to fall.

A = Area of watershed or basin exposed to the rainfall in square feet.

D = Observed depth of rainfall by the pluviometer or rain-gauge in feet.

S = Time in seconds during which the observed depth has fallen.

The following table may be of use in making approximate estimates without employing the formula:

TABLE No. 1.

Volume of precipitation per second of time for a given depth in feet, per twenty-four hours.

Rainfall in 24 hrs.	Vol. of rainfall per second on 1 sq. mi.
FEET.	CUBIC FEET.
0.25	80.6683
0.50	161.3312
0.75	242.1635
1.00	322.8264

From the above table the volume of rainfall can be found for any of the given depths, observed in twenty-four hours, by multiplying the figures in the second column by the area of the watershed in square miles. For depths of rainfall other than those given, the cubic feet per second for one square mile can be found by simple proportion, and then for the whole watershed by multiplication, as before.

Recorded measurements show that the flood volume of streams varies inversely as the area of the tributary watershed or basin. Usually the larger the basin the less in proportion to its area of watershed will be the rate of flow of flood water at its outlet. This is due to the fact that the proportion of pervious soils, open and porous ledges, intercepting stratified formations, easy slopes and still water basins is so much greater in large drainage basins than in smaller ones, that a much larger proportion of the water falling reaches underground courses and receptacles. In small tributary basins the opportunity for loss is much less and the rate of flow consequently greater.

The time when the flood flow takes place at the outlet of a basin, like the rate of flood flow, varies inversely as the area of the basin. In small watersheds and the basins of tributary streams the period of maximum flow follows immediately after the maximum rainfall, while in the main outlet channel of a large basin the flow may not begin for from one to four days, and sometimes even more.

The length of time which the flood discharge from a stream lasts usually corresponds very closely to the length of the storm, although in the case of large basins the discharge sometimes begins after the storm is entirely over, this time being consumed for the first water to reach the outlet.

In the case of elevated watersheds, where

the larger portion of the precipitation comes in the form of snow, the discharge of the flood water coming from the subsequent melting of the snow may continue for a long time, and the effect of a storm may continue for weeks or even months.

DETERMINATION OF FLOOD VOLUMES.

A large number of different formulæ have been invented in different countries for calculating the flood discharges from river watersheds. Most of the experiments made for the purpose of devising satisfactory formulæ have been by Indian engineers. Mr. Dredge proposes the following, which has hitherto been very popular among hydraulic engineers:

$$Q = 1300 \left(\frac{M}{L^3} \right), \text{ in which}$$

Q = Volume of discharge in cubic feet per second.

M = Area of watershed in square miles.

L = Length of watershed in miles.

The record of maximum flood discharges of American streams are few in number, and for this reason it has been impossible to construct a formula especially for this country which would give as close results as might be desirable. In addition to the difficulty due to the insufficiency of recorded observations, another serious difficulty in the way of constructing a general formula for the whole of the United States arises from the fact that there is quite a considerable difference, meteorologically, between extremes of the country. In the New England and Middle States, and most of the United States lying east of the Mississippi river and north of the Mason and Dixon line, hydraulic engineers use the following formula, which has been obtained by comparing the data furnished from measurements taken in that region:

$$Q = 200 (M^{\frac{1}{2}}), \text{ in which}$$

Q = Volume of discharge from the whole area measured in cubic feet per second.

M = Area of watershed in square miles.

To find the discharge per square mile, the formula may be expressed as follows:

$$Q = \frac{200 (M^{\frac{1}{2}})}{M}, \text{ in which the}$$

letters have the same value as given above.

In the southern and western portions of the United States the measurements made

and recorded are even more meager than in the portions already referred to, and as a consequence the formulæ in use for determining the maximum flood discharges of streams are even less accurate.

In the Southern States the best results have been obtained by the use of the formula already given, but in the following form:

$$Q = 250 (M^{\frac{1}{2}}),$$

and in the portion of the United States lying west of the Mississippi River, with the exception of a few localities, the following form of the formula has met the greatest approval:

$$Q = 150 (M^{\frac{1}{2}}),$$

in both of which the values of the letters are the same as already given.

Results obtained by the use of any of the formulæ given above are not claimed to be exact, and can only serve to give some idea of the rates of flow which may be expected from maximum floods in the different localities. In making rough preliminary estimates these formulæ are useful for determining the maximum flood discharges of rivers as well as the approxi-

mately safe proportions of structures intended to span the streams, to divert water from them or to provide spillways for dams. But before any final plans and estimates are made or contracts entered into, the nature and history of the particular locality should be carefully ascertained and studied, and such measurements and observations made as time and opportunity will allow, in order that the formula may be modified to suit the particular locality and conditions involved. For making exact and reliable determinations of the maximum flood discharges from any watershed, topographical, geological and meteorological characteristics must be known and used to modify an existing formula or to construct a new one for use in making the necessary calculations.

The general formulæ already given, when used intelligently, can easily be modified so as to take into consideration the extreme precipitousness or flatness, perviousness or imperviousness of the surface, and the particular degree of precipitation which characterizes the particular basin in question.

(To be continued.)

THE ART OF IRRIGATION.*

CHAPTER IX. IRRIGATING WITH FURROWS.

By T. S. VAN DYKE.

ASSUMING that the ground is fine enough to hold up the small streams of water mentioned in Chapter VII without letting them drop through too quickly, you will generally find it best for all orchard and garden work to irrigate with furrows instead of flooding. You will find this true whether working the ground for pleasure or profit and whether on a large or small scale. Furrows do better and cleaner work and when everything is arranged as it should be the labor is generally reduced to a minimum. The results are those of a long, slow, soaking rain, whereas flooding at the very best has too much of the effect of a short and pouring shower. As flooding is sometimes the cheaper way of irrigating large fields, as in alfalfa, so is the use of furrows generally cheaper in orchard and garden work of any magnitude. To handle a flooding

head on ten acres will take from two to four men according to its size, whereas one man can manage the furrows on ten acres if the delivery flume is fixed as it should be. I have known five acres of lemons furrowed, irrigated and cultivated by a boy of sixteen who lost not an hour from school, and the whole was well done. It was all in the arrangement being perfect at the start.

The first requisite for good irrigation from furrows is an irrigating head of from twenty to fifty inches of water for at least twenty-four hours for each ten acres. The head will vary with the nature of the soil, the product and the length of time you can run the water. Where the soil is quite close in texture and you can have the head for three days at a time twenty inches will do good work. I have seen fine work done with fifteen inches for ten acres, but it was with a four days' run, which gave plenty of time for the smallest

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streams to soak the ground evenly. If you can get a run of only two days or a day and a half, you will need a larger head. Under some ditches you may not be able to get a head for more than twenty-four hours. Then you will need a still larger one, for you will have to use larger streams in the furrows and send them through more quickly to ensure full soaking of the lower end. If the run is so short that you have to use streams so large that they will run muddy or wash and cut too much, then you are at the point where it may pay you best to flood. For to do good furrow work the streams should run clear or very nearly so. If too muddy, they will puddle the furrows and check seepage, while the cutting of the soil and washing off of fertilizers in end-waste are disadvantages easily obviated in flooding and not sufficiently compensated by the other advantages of furrows.

The nature of the crop will make a difference in the amount of head and the length of time you need it. Corn, for instance, will not need so deep a soaking of the ground as trees, although if you have plenty of water you are not likely to hurt it if the water is warm. So for many kinds of vegetables a run of two or three hours will do, and five or six will be enough for most any. Young trees will not need the whole ground soaked so that a smaller number of furrows may do, while such things as olives, that need little water, will do very well even when old and in full bearing without the centers between the rows being wet if a reasonable amount is run near the tree. In the East and other places where the rainfall is nearly sufficient, good enough work for most trees could be done with one furrow on each side, while two on each side should be enough for any. In such countries the shortage of moisture is generally in the top soil, caused by too long a delay in the rain at the time when the fruit most needs it. Consequently such deep soaking is not needed as in the very dry countries and a much shorter run of water generally will suffice. It is impossible to go into detail in these matters. From the analogies of a few cases the reader must work out other cases for himself; but for the dry countries twenty inches for twenty-four hours for ten acres is little more than enough for any kind of vines or trees,

alfalfa or other field crop irrigated with furrows and not enough for most trees when old and in full bearing.

The number of streams into which to divide the irrigating head will also vary with the crop and the character of the soil as well as the size of the head and the length of the run. But if the soil stands the test described in Chapter VII of holding up small streams, the water is quite certain to soak well on each side. Hence, if you can give a long run, the smallest and most shallow rooted vegetation is likely to be wet enough at eighteen inches from the furrow and even on a ridge several inches above the level of the water eighteen inches away. On many soils a long run of water will not wet farther than this; and you need rarely feel any alarm at seeing the top of the ridge between the furrows remain dry long after the water has been running. If the soil will carry a stream of a gallon a minute at the rate of a yard a minute, the water will generally work up to the roots in time, no matter how high you make the ridge.

You may therefore feel quite safe in placing these little streams a yard apart for almost any kind of orchard or field crops. For many things, such as corn, four feet will do; that is, two feet from each row. On the other hand some garden stuff like strawberries that are great drinkers may do better with the streams two feet apart or even less. A few trials on a small scale will settle these questions and you should make them before you proceed farther in arranging the ground.

Suppose you have found that the right distance for your ground and crop is three feet apart for the streams. Ten acres are two hundred and twenty yards square. At a yard apart you would then have two hundred and eighteen streams. If the head of water were thirty inches measured under four inch pressure, as before described, which is about the average required for this kind of work, each stream would be a little over one-seventh of an inch or about one and one-third gallons a minute. Such a stream would need from fifteen to twenty-four hours to cross a square ten acre tract, or six hundred and sixty feet. It might do it in less or take even more according to porosity of the soil and the care with which the furrows have been made. At first it seems ridiculous to

think of doing anything with such streams, but you may be very much surprised when you try them.

Nothing would seem more obvious than the need of uniformity in these streams to ensure uniform wetting, avoid cutting or filling, and furnish a uniform condition for cultivation. Yet the length of time it took to learn that furrows cannot be evenly fed from a larger ditch with earth connections, and the persistence with which thousands of irrigators still cling to such connections when lumber is cheap, are among the strangest things about the errors of irrigation. Bogs here and dry patches there are almost inevitable, unless you do a vast amount of flying about with hoe in hand. When you open laterals from the main feeding ditch, the earth at the junction is sure to cut away in some places and build up in others. In a short time one stream will be nearly stopped and another twice too big. The smaller the furrows, the worse this trouble, though it is bad enough with any. The streams are often stopped by a fallen leaf. I have seen a stranded beetle form a bar at the mouth of one in a few minutes and he was not an extra beetle either. The neglect to secure uniformity of flow in the laterals has been one of the most fruitful sources of loss in irrigation and has made many a one abandon the whole business in disgust.

Putting straw, brickbats, gravel or other similar stuff in the connection is simply recognizing the difficulty and then resorting to the stupidest way of avoiding it. Gates of some kind are so cheap, effective and permanent that in any well regulated State it should be indictable to try to get along without them.

In some parts of California these streams are fed by hydrants placed at the head of each furrow. But these are a needless expense, and need considerable opening and closing at each irrigation to get the proper flow from them. In other places closed aqueducts of terracotta with gates at every yard or so are used. These are more of a luxury than the case requires. Wooden flume which can be made at home is good enough and is generally the cheapest material. Scores of miles of it have been in use at Riverside for many years and are perfectly good today. And whatever is good enough for Riverside is good enough for any part of the world. If made of redwood it will last half a gen-

eration and most any wood well dipped in coal tar will do in most places. There is no law requiring you to put it under ground. You need not worry about the leakage caused by its drying between times. Throw a little fine dirt into it and fire a head of water down it and that is soon settled. With lumber at twenty dollars a thousand on the ground, and the owner doing his own work, a flume of inch lumber one foot square should not cost much over six and a half cents a running foot, as the braces amount to little where there is no pressure. This would be about four dollars an acre for a ten-acre tract, and the best investment ever made. It can be made smaller, but it is well to have it large enough, as it will be dirty and will not run full. Laid on a grade of twenty feet to the mile, it will carry the largest head you want for ten acres. Smaller ones will do where the grade is greater. If you hire the work done, it should not cost over a dollar and a half an acre more. In building it the grade may be kept well enough with a carpenter's level on a plank with a bevelled edge, or with a triangle of three strips of scantling and a stone for a plumb-bob. Or you can turn water into it and let it run as you lay it, as an Indian builds a ditch. Whatever it costs you will in a short time get back with interest compounded hourly, not to mention your prospects of heaven and good digestion caused by serenity of soul.

The gates in these flumes are often a wooden button over an auger hole. But a plate of zinc about two inches square with a slide of zinc running in a raised portion on each side made by two slight cuts is better. Almost any tinker can afford to make these at two dollars and a half a hundred and less by larger quantity. But they can be made at home with old shears out of scrap zinc and be just as effective. Gates of this remain in position better than wooden ones of any form and when once set to an even flow need rarely be touched. The holes can be punched with a wad cutter and need not be over half an inch in diameter, though it is well to make them larger in case large streams should at any time be wanted. After the first regulation of these gates there is little to do but spend an hour or two each time you irrigate, looking over them to see that the streams are about uniform. Here

you may have to take out a little dirt or some leaves or other rubbish, but as a rule, you will have little to do.

As the head runs down in a flume from the discharge of water to the upper furrows, the gates will have to be opened wider. And toward the lower end it may be necessary to tack cleats across the bottom to throw the water out of the gate better. Some use brickbats, stones and such things, but cleats are better. It is best to put them on in the form of a button with a single screw in the middle so that they may be turned enough to give the proper flow with ease.

One of these flumes should be set for every face on which the water is to run. But if two faces meet like the ridge of a house, the water may be delivered from each side at once from a flume set at the top. The five-year old lemonorchard irrigated by the boy above mentioned was of this arrangement. The work is but slightly increased over that of a flume delivering from one side only, and if flume and gates are carefully laid and kept in order, the increase of work in this form is hardly perceptible.

The advantages of this style of delivery are so great that it will probably pay to put in flume and gates even for flooding where the scale is not so great as to make the expense of flume over ditch too great. But for flooding on an ordinary scale, and for all furrow irrigation, no matter how large the scale, it is almost certain to pay. You may make your ditches ever so cheaply and put in box connections with gates at the divides, may have all the canvas dams or iron dams handy to turn the stream from one to the other, and then, when you have summed up all the running about you have to do looking after this and that, and all the cleaning of ditches, all the breakages from gophers, moles or other causes, all the loss of flow from growth of vegetation in the ditches, with other annoyances too numerous to mention, and balance them against the in-

creased cost of a good flume and gates, you may find you have saved nothing in cash and are out a vast amount of time and patience.

The ground all graded to a face or faces of uniform slope and the flume in position, the next thing is making the furrows. These are often made with a common corn-plow and are from three to five inches deep. Four will do for most things unless there is danger of water touching the stalk in some places. There is little danger in making them too deep. It merely is not necessary if they are made with care. The deeper they are, the harder they are to break up in cultivation. The shallower they are, the more liable to break and let the water from one to the other. There is generally plenty of time to do this work and no excuse for slighting it. Every hour spent in making the furrows of uniform depth and as free as possible from heavy clogs, ridges or depressions, or openings into the next furrow will be well repaid after you start the water. These furrows are often made with a corn-plow and sometimes with a cultivator. The latter may be easily fixed to make three at once if the ground is smooth and fine enough. It can be made at home of old beams on the principle of the corn-marker. If made long enough, it would make very uniform furrows very rapidly. But rapid work can be done with the common corn-plow and the boy of the family can do it as well as the grandfather who was raised to the plow. It matters not which way these furrows run. Running at right angles to the flume is but a matter of looks. But they should run on a course and slope that will carry the water as fast as possible without cutting the ground or making the water muddy. And they should always be as nearly parallel as possible. By walking along the flume at the head and looking down the rows you can compare them and see what they are doing much better when they are parallel.

(To be continued.)



THINGS THAT RETARD IRRIGATION.

By WILLIAM REECE.

FIRST—A conservatism that clings to old time customs, notions and superstitions, and opposes scientific researches and new methods of farming on the plains.

Cowboy notions still hold sway, and the ideas and efforts of all tenderfeet are looked upon with mingled pity and contempt.

It is difficult to break away from the old custom of burning off the dry grass and weeds; plowing the ground about two inches deep; of letting the flood waters rush off to the rivers, and of keeping the wind pumps at rest, except when a drink is needed.

Some of the railroads give practical discouragement by their eagerness to grasp the profits from the improved business after individuals have, at their own expense, worked up enterprise and made the country more populous and productive.

A few persons have contributed valuable time and labor to study and advance the true theory of irrigation, without any idea of ever receiving any remuneration therefor, except as they may share the country's prosperity.

Although railroads will receive the first and greatest returns from this enterprise, yet many persons have been compelled to travel at their own expense, to gather from actual observation reliable data by which the natural conditions and the best methods of farming this country may be fully presented to the public.

With the exception of irrigation and agricultural papers and journals, the press has given the matter but little prominence.

Had as much space been given to irrigation in behalf of the farmers on the plains as was given to Corbett and Fitzsimmons, the country would be ablaze with enthusiasm in the great work of making the now barren desert furnish beautiful homes for many millions of American citizens who are now without homes and without employment. The so-called rainmakers have done much in the way of deceiving and misleading the people.

Money, labor and encouragement have been withheld from irrigation, and given

to one of the greatest modern humbugs, that of rainmaking.

The aiding of this silly work by corporations has encouraged many farmers to pin their faith to the rainmaker.

Educational journals, as a rule, shy off from irrigation as too earthly for the consideration of people of culture, and one educational journal in Nebraska is so far removed from things that affect man's happiness here below as to decline to give the matter of irrigation any recognition whatever in its columns. We think that teachers and preachers should not be so ethereal as to ignore those things that make people healthy, wealthy and wise.

Our congressmen have given the matter comparatively little attention.

We do not know whether it is caused by indifference, by fear of being laughed at, or by fear of being censured by the political press.

Ignorance of the meteorological conditions on the plains is another great hindrance to the onward march of irrigation. Men who never spent two years and in some cases never spent two days in studying and experimenting with the elements of earth, air, water, animals and plants are often loud in condemning or ridiculing what they do not understand.

We do not mention these hindrances in a complaining spirit. Railroad managers, editors, congressmen, teachers, preachers and farmers have a right to think and act as they please, but, lack of unity and lack of earnestness in this matter, nevertheless, greatly retards the development of the arid plains.

The great mass of people seem to have given up all hope of reclaiming the great American Desert and are disposed to look upon the few who are firm in the belief that the desert can be made to blossom as the rose as a set of enthusiasts or land speculators.

What our people most need is scientific instruction in all matters pertaining to irrigation, and then concerted action throughout the length and breadth of the land.

Seasons of big crops are not, as is often supposed, seasons of heavy rainfall,

The official records of Nebraska show that in 1883 there was a *good* crop, with fifty inches rainfall, while in 1889 there was a *big* crop with only twenty-three inches rainfall. The condition in Kansas affects crops in Nebraska. A few can take good care of themselves by local ditches, but, in order to make this arid region furnish comfortable homes for the millions of homeless American citizens, the atmospheric condition of the entire region must be understood, and the fierce thirst of the atmosphere prevented by dotting the plains with ponds and lakes, and by burying the wild and impervious buffalo sod with the Indian and the buffalo.

Our President and Congress and the daily press are all wonderfully exercised about a few barren acres in Venezuela and are rushing with break-neck speed to quiet the fears of people in Venezuela, but do not seem to care if the isolated settlers in arid America starve to death and the country becomes a howling, sandy desert.

A large majority of the settlers in arid America are men who spent the best years of their lives in defense of our country.

Congress encouraged them to settle on the plains but now refuses to do anything to make it possible for these settlers to live upon the land for which they paid the government millions of dollars.

If Salisbury would send a modern Stromburgh to run a line around arid America and claim what our government does not seem to care to develop, the natural resource of this fertile region would then be fully considered and appreciated and it would receive the attention it deserves.

Our government in conjunction with States, counties and townships must do one of two things, develop this arid country so that millions can have homes on small farms, or allow our country to fill up with troublesome and dangerous, homeless people.

The perpetuity of our free government demands that everything possible be done to encourage and aid our people to secure homes.

Twenty acres under intensive cultivation will produce more than two townships now do without irrigation in Western Nebraska.

IMPOUNDING STORM WATERS.

BY A. C. ROMIG.

FOUR consecutive years of comparative drought and crop shortage have aroused the farmers of Central Kansas, as never before, to a spirit of inquiry and invention to discover some device by which like casualties may be averted in the future.

They are strongly and favorably impressed with Major Powell's suggestion of impounded storm waters by a system of storage reservoirs, catch basins, dams, and ponds, not alone for the purpose of irrigation, as he suggests, but for increased humidity, evaporation, heavy dews, and possible rainfall as well.

It is a well-known meteorological fact that clouds evaporated from the Pacific Ocean are precipitated on the western coast; in like manner, those of the Atlantic are spilt out long before they reach the center of the continent; that moisture from the great lakes of the north, and the

Gulf of Mexico on the south, seldom reaches beyond one hundred miles west of the Missouri State line, and that in all the vast territory bounded by the Missouri river, the Rocky Mountain range, British America, and the Gulf of Mexico, there are no inland seas nor large bodies of water exposed to the sun's rays for evaporation, hence the necessity of adopting the only available substitute in sight.

When the practice shall have become general throughout the watershed regions of the Missouri and Arkansas rivers, supplemented by the underflow lifted to the surface for the purpose of irrigation, as is now being done in Western Kansas, and if to this be added the additional supplement of deep subsoiling, the problem of relief and immunity from drought, hot winds and crop shortage, will be effectually and permanently solved.

IRRIGATION LEGISLATION.

RESERVOIR SITES WITHDRAWN BY THE GOVERNMENT.

BY CLESSON S. KINNEY.

THE needs and necessity of irrigation legislation which will definitely settle some of the vexed questions upon the subject of water rights are becoming more and more apparent in all of the Western States. In the face of this necessity appear great difficulties. The law of vested rights stands in the way as the greatest stumbling-block. If effective laws had been passed when the country was new, and the various rights which are now vested had not been acquired, the task would be easy. But at an early day the great needs and necessities of the future were not recognized either by the general government or by the various States. It is only by experience that some wisdom comes. In reviewing the legislation of Congress it seems strange that such definite and strict laws were passed relative to the acquisition of title to lands and at the same time let the element which is absolutely necessary to make those lands valuable, take care of itself. This is the experience. The wisdom has come too late in many States. But be that as it may, the fact is that Congress is divested of the power to pass any general law that will govern the subject. It devolves upon the States to work their way out of the difficulty as best they can. That there are difficulties is illustrated by the Supreme Court of Nebraska declaring the irrigation law of that State unconstitutional; by the Circuit Court of the United States declaring the most elaborate law that was ever passed on the subject—the Wright law—also unconstitutional. In many of the States the constitutionality of their irrigation law has not been tested. Several of the States have laws which are copied after the Wright law. All are waiting until the Supreme Court of the United States shall finally decide the question.

GOVERNMENT RESERVOIR SITES.

Some years ago surveyors sent out by the general government located a great number of reservoir sites throughout the

inter-mountain country. These sites as located were withdrawn from the market so that they could not be entered by settlers and are still owned and held by the government ostensibly for the purpose for which they were located. They consist of natural depressions and basins, sometimes dry, but at other times are lakes of considerable size filled with water. The purpose of the government in locating these sites, according to the scheme of Major Powell, was for the government to construct at its own expense these reservoirs, and thus be enabled to dispose of its lands in the neighborhood of the same at a correspondingly higher price. This scheme was all very beautiful if it had been carried out; but when we come to consider that through all these years not a single reservoir located by the government has ever been constructed by it, another phase of the question is seen.

These sites which were located were of the very best that could be found. They are still held by the government, thus preventing their being located by private parties. The only reservoirs which have been constructed to date are those constructed by private enterprise. Many of the government sites would have been located and long before this the reservoirs would have been constructed had it not been for the obstruction of the government location.

One of two things ought to be done. Either the government ought to carry out the original scheme and construct these reservoirs, or the law ought to be modified so that the sites could be located and reservoirs constructed by private parties. There is not much confidence in this western country that the government will ever construct them. But if the sites are opened up for private location the law ought to be so that they can only be located for reservoir purposes and not entered for farming purposes.

CORNERING THE CORN AND THE CATTLE.

A CRISIS IN THE CENTRAL WEST.

PRIVATE letters and dispatches from various points in the central Western States confirm THE IRRIGATION AGE's announcement that a powerful company or a very wealthy individual was quietly buying up the great corn crop at ruinously low figures to hold it for a rise. It turns out that P. D. Armour, of Chicago, is the great buyer. Singularly enough the daily press know nothing of this as yet. Agents of Mr. Armour are working very quietly, but they are gathering in great quantities of corn. Elevators are leased in some localities, in others crib room is rented, and where this cannot be done cribs are built, and all the time corn is being shipped to Chicago, where Mr. Armour has elevators with storage capacity for 30,000,000 bushels. Never before in the whole history of the West was a solid corner on corn so nearly possible as at present. This corn is bought at a price really below the cost of production, and far below what it will bear inside of eight months. The agents purchase at 15 cents per bushel, the farmers, who are in sore need of cash, readily selling at that figure. If Mr. Armour sells finally at 25 cents, it is seen that his profits will be immense, but it is more likely that he will hold for 50 cents. In case of a short crop in 1896 he may get 75 cents or more. Thus does the farming community fall victim to the money king. Instead of a fair profit, the farmers sell, per force, at a loss, while the great capitalist rakes in millions of dollars.

It was known that Mr. Armour was at the head of a syndicate to loan money to stock-raisers on their grazing herds, but this outright buying of the corn crop has been engineered on the quiet. The stock-raisers, like the general farmers, need cash just now and they are borrowing it freely, so that Armour will not only own the corn but he will also have a first mortgage on the cattle market. Of course there is nothing illegal in these operations, but it does seem outrageous that nothing can be done to defeat or check them. Such power in the hands of an individual

or a syndicate is most dangerous. It is often boasted that the farming and live stock interests, if no others, could steer clear and be independent of trusts, but the situation at present indicates the weakness of those boasts. Cattle, hog and even sheep raisers are all falling into the clutches of the combination, the free-wool Wilson bill being responsible for the hard times among the sheep owners.

A crisis has been reached in the affairs of the agricultural and live stock interests of the entire central West and the farmers of the whole country should unite in meeting it. It is idle to deny it longer. Times were never more desperate for central Western farmers than at present. Various crops, except corn, have suffered through drought, and the hog cholera alone has made ruinous inroads. All this being true, holders of corn and cattle are easy victims for the money kings. Cash must be had, and with offers of ready money, the corn is given up and the live stock is signed away. If ever there was a time for united action by the granges of the whole country, it is the living present.

As in Illinois, Wisconsin, Missouri, Iowa and Michigan, the operations of the cheap corn buyers have already been extensive in Nebraska, but there is yet time to succor many of the farmers. The Nebraska Farmer sounds the alarm and makes an excellent suggestion. It asks: "Is not a State, or a county, or a corporation larger than one man? In other words, cannot some system be devised for furnishing farmers with needed money, their bins of corn serving as collateral? By this means whatever of value is in the corn remains with the farmer and the community of which he is a part, and does not go to swell the millions of a man whose fortune represents and is measured by the losses of others. Such men would not be in the field buying up our corn if any adequate protection were provided producers. If the people of the corn belt do not have opportunity to learn a useful lesson this year, we shall miss our guess."

THE DIVERSIFIED FARM

In diversified farming by irrigation lies the salvation of agriculture

CORN AND SOME OF ITS ASSISTANTS.

[Abstract of address by President G. E. Morrow of the Oklahoma Agricultural College, before the Kansas State Board of Agriculture.]

INDIAN corn is America's greatest gift to the agriculture of the world. It is the chief cultivated crop of the United States and of Kansas. The official estimates of the crop of the United States for 1895 give an average of more than 82,000,000 of acres (more than one and one-half the size of Kansas) and a yield of 2,151,000,000 of bushels, valued, even at present low prices, at \$567,000,000. The State estimates of the Kansas crop show an average of well over 8,000,000 acres, or one-half the total average in cultivated crops, and about one-sixth of the total area of the State, and a yield of 201,000,000 of bushels. It may help us to get some idea of the enormous quantity these figures represent if we recall the fact that the Kansas crop would fill a crib ten feet wide and ten feet deep and 900 miles long, or would make a tower covering one acre and reaching two miles into the air.

Corn is a true grass and we have underestimated its value by thinking too exclusively of its seed—not fully recognizing the great food value of the stalks and leaves. It is a conservative estimate that the value of these per acre equals the value of one ton of good grass hay. In the corn growing regions corn stalks may well be substituted for timothy or prairie grass hay. The silo admirably preserves the stalks or the entire plant. With the aid of the recently improved machinery for shredding the stalks they may be put into almost ideal condition, when it is not convenient to have a silo. Aside from the percentage of water, corn fodder has a chemical composition not materially different from that of the hay grass. The food constituents are digestible in large degree but the large stalks are not in shape to be readily eaten. Made into ensilage or shredded, this difficulty is largely removed.

Corn is long to remain the great grain food for American farm animals and will, probably, be more largely used as food for man in the future. Almost entirely new uses will be found for the grain as well as better methods of utilizing it for its present uses.

There is great difference in the value of different varieties—especially in their adaptation to different climates and soil. Much has been done in the improvement of varieties, but much more remains to be done. It is believed possible to develop corn so as to better adapt it to a dry climate than are the varieties we now have. Much experience shows the impossibility of corn having all good qualities in the highest degree in any one variety. For Kansas especially, those parts most subject to hot winds and drought, medium large varieties ripening as early as practicable seem best. There is much advantage in having the stalks of moderate height, with short joints, giving greater leaf surface.

In a greater degree than in some other regions early planting is important. Probably nowhere is thorough preparation of the soil before planting more important. Subsoil plowing will be helpful on much Kansas and Oklahoma soil, largely because of its effect in enabling the soil to absorb and retain more moisture.

If anything has been proven by experimentation in regard to corn, it is that deep cultivation of the growing crop is generally injurious—especially after the plants have made much growth. Root turning is almost always a necessary evil at the best, and the less of it that is done the better. In dry seasons the roots are not so near the surface. No positive rule can be given as to depth. In Central Illinois three inches was found as deep as it was desirable to stir the soil in cultivating the crops. Were it not for the action of the strong winds, a level, finely pulverized surface is clearly the best.

The number of stalks per acre for the largest yields varies somewhat with the

size of the mature stalk but probably more with the climate—decreasing as we go north. A regular, uniform “stand” is an essential to a large yield. Overcrowding is to be avoided but an insufficient or uneven stand is a frequent source of small yields. Probably from 8,000 to 10,000 stalks per acre may be a fair range for Kansas.

The food value of the crop increases until the plants are fully matured; the total dry matter increases greatly even after the stalks have reached their full size. There is some loss from winds blowing off tassels and leaves.

Valuable as corn is, it cannot do everything. It needs assistance. We cannot afford to grow it year after on the same soil. A rotation is helpful in many ways. For much of Kansas alfalfa is an admirable crop both as a means for helping maintain the fertility of the soil and because of its great value as food. Whenever it will thrive it should be grown in increasing quantity.

Kansas and Oklahoma farmers are recognizing the folly of fighting against nature's laws.

Eleven counties in the eastern fourth of the State grew more than one-fourth of the crop of the State. Twenty-four counties in the western fourth grew about one-fortieth of the crop—eighteen of these growing only about 1,500,000 bushels. For the regions with insufficient rainfall the sorghums, especially the Kaffir corns, give promise of very great value. One of the great fields for work for boards of agriculture and experiment stations in the regions of light rainfall is in improving the varieties and in learning how best to cultivate and feed this great crop of the future.

TRENCHING IRRIGATED LAND.

BY F. C. BARKER, NEW MEXICO.

TRENCHING is seldom practiced on irrigated land; partly on account of its cost, and partly because it is very little understood in this country. The European market gardeners trench their ground regularly every two years at least, and I am convinced that it would pay on all land where the crop to be raised is a valuable one. The operation consists in thoroughly pulverizing and

manuring the soil to a depth of eighteen to twenty-four inches, and it is needless to point out the great superiority of soil thus worked as compared with land manured and plowed in the ordinary way to the depth of, say, six to eight inches. Not only is there a much greater supply of plant food, but the loosening of the land to the depth of eighteen inches enables it to hold a greater amount of moisture, as every one knows who has tried subsoiling.

For the benefit of those who have never seen trenching done, I will briefly state how I do it myself, as the operation is somewhat different where irrigation is practiced from what is the rule on unirrigated land. In the first place the work should be begun as early in the fall or winter as the time can be spared, in order that it may be finished at least a month before the land is cropped. To begin with, cart onto the land barnyard manure at the rate of not less than sixty loads to the acre. Spread this and plow it under as deeply as possible. If necessary harrow or drag the land and then give it a good irrigation, so that the soil is moistened to the depth of at least two feet. Now leave the land for say, fifteen to twenty days, or until it gets sufficiently dry to work with the spade, and cart on sixty loads more of manure to the acre, depositing it in small heaps at a distance of about sixteen feet from heap to heap.

Having provided yourself with a sharp digging spade eleven inches long, proceed to dig out a space four feet wide and one spit deep along one end of the piece of land. Wheel or cart this soil to the other end of the land, as you will need it to fill up the last trench. You will now have a trench four feet wide and one spade deep, onto which throw manure, and having spread it dig up this trench one spade deep, mixing the manure with the soil. Then dig up another stretch four feet wide, throwing the soil upon that which was last dug. Now manure and dig the second trench and continue the process until you get to the other end of the land, where you will find the soil for filling the last trench. You will thus have the whole field dug and manured two spades deep. In actual practice I find that the first digging does not leave the trench over seven inches deep, as the spade on loose soil does not clear out all the earth, a good deal of it falling from the spade; but the second digging

goes fully eleven inches deep, thus leaving eighteen inches of well pulverized and manured soil, which would when finished be again irrigated, so that the manure is rotted before the crop is planted.

As regards the cost, this will depend upon the texture of the soil and the class of labor employed. A man accustomed to the use of the spade will do fifty per cent more work in a day than a novice. I have employed native Mexican labor, paying them seventy-five cents per day and I find that when they get used to the work two men will trench an acre of land in twenty-four days, bringing up the cost to \$36 per acre. This does not include the cost of manure, and the hauling and spreading of same, nor the first plowing.

Of course, only expensive crops, like garden truck, strawberries, and other berries, will pay for this intense culture. In the case of strawberries the farmer will take three crops off the land before it again needs trenching, and I think anyone will admit that land thus cultivated will easily produce 1,000 quarts per acre more than land treated in the ordinary way; or a total crop of 4,000 quarts instead of the usual average of 3,000 quarts. Reckoning the strawberries at five cents per pound on the vines you have a gain of \$150 per acre during the three years to pay for the cost of trenching.

On many soils it would pay to bring the bottom spit to the top and so have virgin soil in which to plant. The trenching is then done in the following manner: First, dig a trench twenty inches wide and eighteen inches deep. Then dig twenty inches wide and one spade deep and throw the soil into the bottom of the trench. Then dig the bottom spit of the second trench and throw it onto the top of the first trench. In following this system of trenching, manure the top of the land as already described. This top soil will be placed at the bottom of the trenches and the soil brought up by the second spading will need manuring after the land is all trenched. This can be done by hauling the manure onto the land, spreading and plowing it in.

I believe it will pay to trench land for all crops like cabbage, cauliflower, strawberries, raspberries, blackberries, gooseberries, and currants, that need a very deep and rich soil. No deep plowing can

in any way approach it. One hears of plowing ten inches deep, but take a foot rule and measure it and you will generally find only about seven inches of soil cultivated. Of course, cultivation with a plow, followed by a subsoiler, is much cheaper, but you will want four very good horses to stir the soil eighteen inches deep, and then you only have the top half manured, whereas by trenching you have eighteen inches of cultivated and manured soil.

IRRIGATION AND FERTILIZERS.

BY E. M. SKEATS.

FARMING under irrigation and farming in an arid climate with artificial water supply are generally synonymous, but the two phrases suggest distinct trains of thought. Very much has been written on farming under irrigation and its advantages have been eloquently set forth by many. The advantages are usually summed up in abundant sunshine, abundant water and therefore abundant crops.

But has experience in irrigated districts corroborated these claims? In a few instances no doubt it has, in more instances it has not, and why? Chiefly, I venture to say, because the peculiarities of an arid climate are not sufficiently recognized by the farmer from the rain belt.

Every district has its own peculiarities of climate, water and soil, but there are certain things common to nearly all arid countries and these are:

1. Abundant bright sunshine.
2. An abnormally dry atmosphere.
3. Clear, cool nights with excessive radiation of heat into space.
4. Soil rich in inorganic plant food but almost destitute of nitrogen except in a few favored spots.

To make the most use of the sunshine the water and the inorganic riches it is absolutely necessary to supply nitrogen to its full amount. It is desirable to render the atmosphere more humid for most crops, and for many plants it is imperative to take the night radiation into account; any overshadowing will lessen this, such, for instance, as the proximity of a tree.

Time and diversified farming over large areas will do all we want, but we cannot afford to wait, and need not.

To get big results from the land chem-

ical manures have been tried by many with fair results, but with what a waste of money! All the constituents paid for except the nitrogen might generally have been dispensed with.

For arid lands, as a rule, good stable manure from animals fed on leguminous hay is by far the best fertilizer, and a liberal use of it by the first settlers is essential to full success.

Next to this the best results will probably be had by the plowing in of leguminous crops such as clover, alfalfa, cow-pea vines, etc., and they should be plowed in in the fall and the ground kept moist through the winter.

Every farmer, too, should so manage his farm as to have a leguminous crop come off all his arable land at least once every other year if possible, and he should take care to see that his very soluble nitrates are not leached out of his soil during the process of irrigation. I think he will find that heavy winter irrigation will go very far to prevent this. The nitrates have not formed to any extent by then, and the water deep down in the soil will act as a supply for half the summer, rendering a minimum of irrigation necessary in the hotter growing months.

The humidity of the atmosphere may but be obtained by the planting of trees and covering the ground with crops. I think it will be found that with young orchards, especially in new districts, more and better growth will be had amid corn or other tall plants than in the open with clean cultivation. The moisture evaporated from the large leaf surface is accountable for this in great part. I need hardly add that the water evaporated thus into the air must be met by increased irrigation for the trees.

SORGHUM FOR SYRUP AND FEED.

BY MARY BEST.

MANY readers of *THE IRRIGATION AGE* have written asking for further information about sorghum, especially the varieties best suited for syrup. I am glad to be able to answer such inquiries as far as possible through the magazine.

Mr. A. A. Denton, who had charge of the extensive government station at Sterling, Kansas, has kindly permitted me to use any of his reports on this subject, and

I have also availed myself of the results gained at the station at Medicine Lodge. It is singular how little people appear to care as to what variety of sorghum they buy, and yet it is of the first and last importance to learn which kind is best suited for their purpose, and then, above all else, to see that pure seed alone is used.

I have been looking through the catalogues of several large seed houses and, while they advertise new and improved varieties of almost every other grain or forage plant, not one word is said about sorghum except the same old song. "Amber and orange" as special for syrup, and a general lump sum of "other kinds for fodder." This is the more remarkable when we know that any one interested can so easily learn from the reports that in the thorough and comprehensive work done by the U. S. Department of Agriculture "amber and orange" have been entirely superseded by Folgers and Colman, and that out of the hundreds of other varieties Collier alone stands equal with the two last named. The United States through the Department of Agriculture have spent an immense amount in the work of sorghum seed improvement and selection, not only showing how to accomplish this, but actually doing it on a scale never equaled, not even by the work in Europe on beet seed. Perhaps about no other plant in America is the information so complete and definite, or so little appreciated. It may be that the very luxuriance of the plant, its ease of cultivation, and grateful response to a little care and attention make people careless and indifferent to the great possibilities under the best conditions.

There is really little difference in the so-called varieties, being more agricultural than botanical. In 1888 there were many hundred different names; the whole work since then has been to select the best, discarding all others, and to improve the few chosen. In 1892, four varieties were acknowledged ahead of all others and especially desirable from a sugar standpoint for their quality of remaining true to parent feed. These were Folgers, Colman, Collier and Planter. The latter had no special advantages not embodied in the other three, and therefore has been dropped for general cultivation, as it lacked some of their virtues.

At Medicine Lodge and Sterling gov-

ernment stations and by private growers, it has been shown that Folgers is the best early cane. It has all the advantages of early maturation of amber, and is superior to it in every respect—in yield per acre, sugar content, and for syrup making. Mr. Denton, on being asked which is the best cane for syrup, replied, Folgers, for it is the one out of all others yielding a large amount of syrup that does not crystallize. While it is a week or ten days later than amber in ripening, yet in all tests of the two we have found one hundred days after planting it had an equal amount of sucrose.

Colman is a splendid cane. A cross between amber and orange, it is far ahead of either; it is firmly established and not only maintains the high standard reached, but improves from year to year. It is of great value for sugar, gives a large tonnage, and is a good resister of drought and frost, giving also a heavy seed crop. As a good cane for feed it is only surpassed by Collier.

The Collier is the third selected as being superior with Folgers and Colman to all others, and is recommended as the best variety for northern latitudes where sorghum is grown for sugar. Its sugar content is very high, and as winter feed it is simply perfection—tall, sweet and slender stalks, with an abundance of foliage which is resistant to frosts, and with the light seed heads stands up well even against our Kansas winds and calamity howls. It ripens early although a late cane and can be planted as late as June 15, and still mature. It gives a fine quality of syrup, which, however, very soon turns to sugar.

Wherever corn can be grown sorghum will flourish and will bear drought infinitely better. On the other hand we have a few acres planted on land irrigated a week before seed was put in, and this crop is still standing for the reason that the only way we could devise to harvest a forest of sorghum, was to turn in the cattle, and let them eat at leisure. No machine we have can cut it.

It looks as though the knowledge gained and money spent on perfecting this great plant was being rapidly wasted. Very few people are keeping their seed pure in this district. It is a thousand pities to have it all lost, for apart from the sugar question which is rapidly changing for the better,

as a forage plant alone sorghum is more valuable as it is kept pure and each variety grown separately.

SOILS AND PLANT FOOD.

BY H. R. HILTON.

[Extracts from paper read before the annual meeting of the Kansas State Board of Agriculture.]

PLANTS need food, like animals, and, like animals, do best on a balanced ration.

The essential elements of this balanced ration obtained from the soil are nitrogen, potash, phosphorus, lime, magnesia, iron and sulphur. If one of these is absent from the soil, or not in available form, the plant will be defective. If either nitrogen, potash, phosphorus or lime are absent, the plant will be short-lived. All of these elements are needed, and if one be missing, that one controls the life of the plant.

Assuming that all food elements required are present in sufficient supply, four important agents must still co-operate before the seed can germinate and the plant partake of the foods provided. These are heat, air, water and light. If there is a deficiency or excess of either one of this quartette, plant life suffers; if all are present in right proportions the plant reaches its highest perfection.

Each plant has its own requirement of heat, air and water, but when a fine textured soil has a temperature of 75° to 90°, F. and contains 20 to 30 per cent of its bulk of water, or 16 to 20 pounds of water to each 100 pounds of soil, and the air can permeate freely, it is in the most favorable conditions for the growth of our ordinary field crops.

The mineral elements of plant food are usually abundant in our western soils. Some, like potash, are most abundant where the rainfall is least, and least abundant where the rainfall is greatest.

Nitrogen, a product of decaying animal and vegetable matter in the soil, is the most costly, the most easily wasted or lost from the soil and the most valuable to the plant itself of all the food elements obtained from the soil.

Organic matter (i. e., animal and vegetable matter) in its various processes of decomposition in the soil is called humus,

The products of this decomposition are ammonia, carbonic acid and water. The agencies in this work are micro-organisms in the soil. The ammonia is converted by other micro-organisms into nitrous and nitric acid. The carbonic acid acts on the mineral elements of the soil and aids in rendering them more soluble and available to the plant.

The work of these lower organisms is important. German and French investigators have found from 500,000 to 900,000 germs in a gram of soil (less than half a cubic inch).

These micro-organisms can only exist where organic matter is present and will be many or few as organic matter is abundant or scarce. They are dormant when the temperature of the soil is below 39° F. or above 115° F.; dormant when the moisture content of the soil falls below 8 to 10 per cent, or about one inch in depth of water to one foot in depth of soil; dormant when the soil is fully saturated with water and dormant when air is excluded either by too much water in the soil or by soil compaction. They are most active when the soil is about half saturated, i. e., from 20 to 30 per cent of the bulk of soil, or say 16 to 20 pounds of soil, and when the temperature of the soil is 75° to 90° F. and the air has free access to supply oxygen.

Many farmers consider the destruction of weeds the important object of cultivation, but this is secondary to the maintenance of those favorable conditions in the soil that will secure the presence of air, water and heat, so related as to promote the highest development of the plant.

In applying stable manure to the soil organic matter is being supplied for the bacteria to work upon, and to get the most value out of the manure, soil conditions favorable to the nitrifying processes must be maintained or much of this valuable promoter of fertility will be wasted.

We have little control over the temperature of the soil, except as it is warmed in the early spring by cultivation, or lowered at mid-summer by shading the ground with green foliage. Our soil temperatures are not excessive even in mid-summer if a corresponding proportion of water is maintained, but a deficiency in the water supply makes a lowering of the soil temperature desirable while the deficiency exists.

The air is always within reach and available when the soil is in permeable condition.

Time to Irrigate.—When to irrigate is a serious problem with many, especially so with new settlers. To lay down an inflexible rule for irrigation would be absurd. One answer is, to watch the appearance of the crop and give water as the condition demands it. Root crops will thrive best if irrigated frequently. Corn when small should have but little water, quite frequently none until it is several inches high, but when it is earing out it will require a great deal of water. This is true of all crops when the grains are filling out and the most rapid growth is being made. The water should be shut off when the grain is hardening.

To allow water to stand about the plants with a hot sun shining on them is often fatal. Cabbage and even alfalfa in some soils can be killed in this way. The application of water to growing crops is a matter that requires a great deal of investigation. There are so many conditions to be considered and different objects to be accomplished that comparatively little is known as yet of this science. Both quality and quantity are regulated by the use of water; then what is best in some soils is not good in others, so that the old timer even finds new difficulties to contend with when he changes his location, even though but a few miles away.

Winter Water Reservoirs.—The winter rains and snows are a constant source of waste of water that might be held in natural basins or easily constructed reservoirs for use in irrigating during the coming season. There is no better time than the present for irrigators to investigate the subject of securing an independent source of water supply. Land without water is almost worthless in many sections of the West, yet with a sufficient supply to meet all the demands for irrigation the land becomes valuable in proportion to its location and fertility.

If the soil is of a character to admit of constructing catchment reservoirs every available location should be used. In the foothills of most mountain valleys are basements covering from one to fifty acres where, with a little work, a large body of

winter water can be stored. Small channels, made with an ordinary plow, will be sufficient to lead the water from a large area to the reservoirs. In this manner the rains, that otherwise would only swell the mountain streams and run away causing frequent floods and destruction of property, can be utilized and made to furnish moisture for the next season. The snow is a prolific source of supply for these reservoirs, and many small streams of winter and early spring can be trained into the channels leading to the reservoirs.

The Woolly Aphis.—Cyrus Marshall, of San Marcos, California, gives this remedy for the apple tree pest as follows:

"Some six years ago I found fifteen or more apple trees infested with woolly aphis. The trunks were more or less covered with them and they had distributed themselves on the higher branches on most of the trees. I had a mixture, kerosene, of course, being the principal ingredient, and applied with a very small brush to the parts affected. As fast as I killed them they came up to the roots and appeared again upon the trees.

I consulted all the men I saw who were learned upon the subject of tree pests, and received from each a remedy, none of which was a success. The second year, after vainly working, I dug deep around each tree and found masses of diseased roots attached to the main roots, woven together in labyrinth, and from three to four inches in diameter. In the interstices were thousands in different stages of development. I cut these diseased masses of roots clean from the trees, and put around each tree two or three gallons of hard-wood ashes, and then filled up with the earth. It was not necessary to repeat the experiment, except with five or six trees, and did not lose one, and have since had no woolly aphis."

Care of Fruit Trees in Winter.—When trees stand too thickly in grown orchards, excluding air and sunshine, all inferior trees should be dug out. Each tree to bear well should be exposed to the light on all sides. Many a cord of wood might be taken from most orchards and yet plenty of trees remain to serve their purpose better. Remove all rough dead bark from the trees with a scraper, and

whitewash the body of the tree nearly up to the limbs. This destroys all insects, the bark will be renewed and the whole tree restored. The scrapings, however, must be burned or the pests will live on the ground. This work can be done any time during the winter.

Our Poultry Population.—No account was taken of the hen product until the census of 1880, when it was found that we had approximately 100,000,000 fowls in the United States, laying nearly 457,000,000 dozen eggs. During the subsequent ten years the number of fowls had more than doubled, though the increase in the egg product was not so great, doubtless because of the greater consumption of broilers. The exact figures are as follows:

Census.	Fowls.	Geese, ducks and turkeys.	Doz. eggs.
1890.....	258,472,155	26,816,545	817,211,146
1880.....	102,265,653	23,234,687	456,875,080
Increase.	156,206,502	3,581,858	360,336,066

The increase in the number of fowls was 153 per cent between 1880 and 1890, and of eggs 79 per cent. Estimating the value of eggs at 12 cents a dozen on the farm the year through, we would have the egg supply of the United States worth \$55,000,000 in 1879, and \$98,000,000 in 1889. Taking the farm value of a fowl at 25 cents, we should have \$64,618,039 as the representative value of all American hens. Adding this to the \$98,000,000 for eggs, we get \$162,618,539 as the value of the fowl crop of the United States. This is 150 per cent greater than the value of all American sheep in 1895, and \$62,000,000 greater than their value in 1890.

One Acre, with Irrigation.—The following is a closely estimated average of crops raised on one acre in Otero county, Colorado, last year: Wheat twenty-six bushels, oats thirty-seven bushels, rye thirty bushels, barley forty bushels, corn forty-one bushels, beans twenty-two bushels, potatoes 160 bushels, sweet potatoes 110 bushels, peanuts 150 bushels, tomatoes 325 bushels, sugar beets twenty-two tons, alfalfa five tons; cabbage, sold at two cents a pound, eight tons, cantaloupes, sales for an acre, \$248.30, net \$203.20; watermelons, sales for an acre, \$134.40, net \$96.40.

LEGISLATION THAT IS URGENTLY DEMANDED.

THE National Grange, various State Granges—among them the strong Illinois body—and the Illinois Farmers' Institute, all recently in session, demand from Congress and the Illinois and Indiana State Legislatures pure food laws—laws which shall suppress the manufacture and sale of bogus butter, bogus cheese and bogus lard. And the National Dairy Union, which has just closed its session in Chicago, voices the same just demand. Committees were chosen by the Union to wait on Congress and the Illinois and Indiana Legislatures. Other Western and Central States, except Illinois and Indiana, already have State laws to protect honest products.

THE attention of Congress and the Illinois Legislature is also called to the fact that a great and extensive business is done in Chicago in horse meat—sold as beef. The stuff could be seized in hundreds of meat markets at any hour any day. Horses are not only slaughtered here but supplies of corned horse are received from western points in barrels and cans.

ANOTHER meeting, with more credentialed delegates than there are to a national political convention, has also just been held in Chicago. This was the first annual meeting of the National Association of Manufacturers. About 15,000 people were in attendance, representing manufacturers of the country worth hundreds of millions of dollars. A national organization of the manufacturers was cemented, and that great organization proposes to have a voice in regard to future legislation concerning the manufactures, trade and commerce (domestic and foreign) of the United States. Its very reasonable demands for the present will doubtless be granted by this or the succeeding Congress.

THE far Western States are waiting on Congress for an act giving them the arid land grants outright, and the Territories

ask to be included in the measure. A Government Commission for the regulation of irrigation water supplies has been recommended by Commissioner Lamoreux. Western America is also waiting on the United States Supreme Court for a decision of the constitutionality of the State District Irrigation laws.

THE commercial bodies of the country demand a much more thorough recognition of the business interests by the government, and the bill in Congress for the establishment of a Department of Commerce will doubtless be pushed through. The head of the department will be a member of the Cabinet. It is suggested that the scope of the new department should be extended to embrace a general supervision of the tariff.

MEMBERS representing \$100,000,000 worth of lake vessel property attended the annual meeting of the Lake Carriers' Association at Detroit. Congress was memorialized against the proposed railroad bridge over the Detroit river, and in favor of deep water in the connecting rivers and canals. The proposed bridge at Detroit was denounced as a scheme of the new railroad trust to cripple the lake shipping and retard quick shipments by water.

THERE is nothing preposterous at all in the demand for free rural mail delivery. It can be performed cheaply enough by postmen on horseback or on bicycles. Every agricultural paper in the country should advocate this proposed measure, so that farmers may receive their papers soon after they reach the country post-office.

FARMERS are crying out for the seed distribution, and a bill is to be introduced forcing Secretary Morton's department to furnish them. That investigation of the Agricultural Department will bring out a long list of complaints.

MANUFACTURES AND TRADE

DELEGATES to the first annual meeting of the National Association of General Manufacturers, just held in Chicago, represented an invested capital of \$2,000,000,000; while the delegates to the meeting of the Textile Manufacturers' Association of the West and South represented an invested capital of \$40,000,000. The latter includes both woolen and cotton interests. These two great associations held separate meetings, with one joint session. The common aim of both is protection to home industry and extension of American trade to foreign nations, and the Textile Association adopted ringing resolutions for Congress on that subject.

The general manufacturers' meeting called the attention of Congress to the fact that Japanese goods are flooding the American market, and called for a halt. The report of the committee on resolutions, which was adopted, asked for a uniform classification of freight from the Interstate Commerce Commission. It also advocated the establishment of an industrial exposition in the City of Mexico; that a Department of Manufactures be established under a secretary of equal rank with the Secretary of Agriculture; that the inequality of traffic conditions in various States be investigated and righted if possible, and that the Senate of the United States is earnestly requested to pass promptly and send to the President the revenue bill lately adopted by the House of Representatives. The meeting was unanimous for the completion of the Nicaragua canal. Trade agencies in South America were determined upon.

The speech of Hon. Wharton Barker, of Philadelphia, before the Textile manufacturers, was a great feature, and was closely followed. He urged that protection and bi-metallism must accompany one another.

A decision of various points in the Interstate Commerce Act has just been made by the United States District Court in Chicago in ruling on the Santa Fé and Nelson Morris indictments. The big packer was freed from his troubles, the indictments relating to him being quashed.

John A. Henley, traffic manager of the Santa Fé, and ex-President Rinehart of the same road were adjudged to have been properly indicted. The indictments against Isaac Thompson, a Kansas City shipper, and Manager Jenkins of the Hammond Packing Company were quashed. The court holds that a shipper cannot be punished for accepting a rebate, but that it is right and proper that carriers be held for discriminating against the public. The railroads of the country will take the general issue of the law to the United States Supreme Court.

VENEZUELA has just taken her first step in commercial warfare against England. George Turnbull, of Boston, who claims part ownership in the great iron mines in the Imataca mountains, not far from the mouth of the Orinoco, and within the territory contested by England, started from Great Britain with a ship load of mining machines and material which were consigned to a firm in Ciudad, Bolivar. At that place, when he offered to pay the duty on the machines, he was told that he had violated the law in not going to the point originally appearing in the manifest. He was further informed that his act was regarded as an invasion of Venezuelan territory and that it was probable that his machinery would be confiscated.

THE consensus of opinion among well-posted men is that prices of cattle and hogs will show quite a gratifying advance during the next sixty days.

AN International American bank was one of the recommendations of the Pan-American Congress and was suggested by the late James G. Blaine. A bill for such an institution is now being considered in Congress.

WHILE general trade has not shown a widespread tendency to revive from the holiday depression, there are favorable features in a revival in iron and steel prices, and continued heavy cereal exports.

"PATRONIZE home dealers" is the motto being generally adopted in the

towns and cities of the Western States. In other words, dealers agree not to buy from people outside their city and their State anything that can be bought (reasonably) at home. It is State protection of home industry and home products. If outside cities and States are real good, sales will be made to them.

THE annual meeting of the Lumbermen's Insurance Company and the Northwestern Lumbermen's Association was held at Minneapolis, with 350 delegates. The insurance company has a surplus of \$4,000. J. A. Smith, of Osage, Iowa, was elected a director in place of W. H. Robinson, of Mayville, N. D. In the lumber association there are 905 great lumber yards. President Tutthill (of South Dakota) spoke for arbitration of claims between wholesalers and retailers, and urged that the reciprocity scheme between large and small lumbermen be put into effect.

THE Illinois Farmers' Institute had a successful meeting at Springfield. The papers on agricultural topics were of a character to lead farmers into lines of valuable thought. The officers elected were: President, F. M. Palmer, Clinton; vice-president, W. E. Robinson, Greenville; secretary C. F. Mills, Springfield; treasurer, T. W. Wilson, Springfield; superintendent of institutes, C. F. Mills, Springfield.

GOLD held by the National banks of the United States is \$165,000,000. Of this, the National banks of Illinois hold one-eighth—\$20,000,000. New York banks hold \$50,000,000.

A GENERAL convention of the Southern cotton growers, held at Memphis, resolved to reduce the area of cotton planting. They will use the spare acreage for corn and other crops. If India, Egypt, Argentina, Polynesia, and other countries rush their cotton in here, they will simply ask for protection.

A STRONG company has been organized to work the Indiana oil fields and crowd the Standard Oil Company out.

APPARATUS "for running a farm by electricity" is what Israel Hogeland, of Chicago, insists he has invented. Instead of a network of trolley, an insulated wire long enough to reach across the fields to

be worked is all that is required by the new invention. The motor can, of course, be attached to an innumerable number of farming implements.

A MEMORIAL has just been forwarded to Congress by the National Live Stock Exchange asking for legislation looking to reciprocal trade with foreign countries.

THE National Dairy Union elected officers as follows: President, W. H. Hatch, Missouri; vice-president, J. E. Keith, Illinois; secretary, D. W. Wilson; treasurer, G. W. Linn. Chicago Produce Exchange Committee on legislation: W. H. Hatch, Missouri; James Hewes, Maryland; H. C. Adams, Wisconsin; W. K. Boardman, Iowa; George M. Whittaker, Massachusetts; E. F. Webster, Ohio; J. E. Keith and G. W. Linn, Illinois; W. A. Hudson, St. Louis, and H. C. Christian, Wisconsin.

OFFICERS of the Union Stock Yard and Transit Company this year are as follows: Nathaniel Thayer, president; John B. Sherman, vice-president and general manager; J. C. Denison, secretary and treasurer; James H. Ashby, general superintendent; Richard Fitzgerald, superintendent of Transit Department.

THE demand for export sheep is not as good as it was a few weeks ago when prices were forty to fifty cents lower. There has not been improvement enough in foreign markets to warrant extensive shipments at the prices. However, much space has been engaged by sheepmen, and they will have to fill it or sublet it to cattle shippers.

SECRETARY SMITH, like Secretary Morton, opposes everything at all in the interest of, or for the relief or advancement of, the West. He is now fighting the Free Homestead bill before the House committee on public lands.

SEVERAL Chicago, Duluth, and Minneapolis vessel men and shippers have concluded to make their through rates to Europe sure and uniform, and they are buying steamers for an ocean line from Boston to English and German ports.

FRANK E. WAGNER, elected secretary of the National League of Commission Merchants of the United States, is a member of the commission firm of G. M. H. Wagner & Sons, of South Water street, Chicago.

THE PROGRESS OF WESTERN AMERICA

A MONSTER COLONY FOR NEW MEXICO.

BY HORATIO.

EVERY city and town in the United States today has idle people. Chicago has 30,000 men who cannot get steady employment, for the simple reason that every place is filled. These people are not drunkards or loafers, and many of them are skilled in the trades. The type-setting machines alone have thrown half a million printers in the United States out of all chance of further employment at their trade, and before the machines came the electric lights had rendered many of them half blind. The condition of the printers today, most of them with families, is indeed pitiable. The Western State or Territory that wants population, and wants to advertise itself at the same time, can secure a monster colony by *giving* each ex-printer a small tract of land, with the privilege, in the future, of *buying* additional acres.

The men who are in the sorest need are newspaper compositors, and THE IRRIGATION AGE feels sure that once the suggestion is made the newspapers of the West will take it up. We ask the press to aid us in founding a printers' colony, and thus succor half a million as good men as tread God's green earth.

That such a colony would rapidly fill up goes without the saying, for printers all over Europe and all over the world are in the same sad predicament as those in this country. From long service and night work, hundreds of these men are worn down and weak, but they will rapidly recuperate. If a companion is necessary, the American printers today are in much worse condition than the Armenians, and these men and their families are *Americans*, and are the wards of, and made, the newspapers which now do without them.

Will New Mexico do itself honor and at the same time perform a national charity

by offering homes to these suffering people?

Communications on this subject from Territorial and State officers, or Territorial, State or County immigration bureaus can be addressed to THE IRRIGATION AGE, Chicago. Leading men in printers' societies in Chicago, St. Louis, Cincinnati, New York, Memphis and New Orleans, agree that such a colony as is suggested, would prove a blessing, and they are enthusiastic to push the suggestion to an established fact. If our friends of the western press desire to know the feeling among the fraternity all through the West, let them step into the composing room and "sound" the "subs" that are standing around, or send reporters to the headquarters of the Union or other printers' societies.

If a favorable offer is made by New Mexico, or some other Territory or State, THE IRRIGATION AGE has arranged to immediately place it before meetings of the printers in every city and town in the United States, and such a noise will be made that it will be heard all over Christendom.

But the terms must be awfully easy. It must be remembered that most of these men have been without employment for a long time; that close application to type-setting for most of their lives from boyhood up almost unfits them for other city employment. These men are poor now, through no fault of their own, but if given a chance they will quickly become much more than self-sustaining.

And, without reflecting at all on gentlemen who make a business of colonizing, we wish to have it understood that in no way can there be any money in the project for THE IRRIGATION AGE. If offers are received of homes for these deserving and desirable people, those offers will be immediately turned over to the printers' societies. Our services are free, gratis, for nothing.

worked, hundreds and thousands of additional acres of land will be opened up to agriculture through irrigation. Utah, as a State now, will forge ahead to even greater prosperity than at present, and she already has much to boast of. Out of more than 20,000 farms today, only 2,000 are in any way incumbered. Nine out of every ten Utah farms are clear of mortgages. And as to the richness of Utah's mineral resources, there is no need to speak just now. New Mexico, Arizona and Oklahoma, have made such strides that their showing gives substantial foundation for their demands to be admitted to the Union as States. The new State of Washington has made unprecedented advances.

Irrigation has made Western America. It is the bountiful crops on former arid lands, through irrigation, that have attracted attention of late and made more thorough mineral development possible, and the mineral development, in turn, will aid irrigation to continue its grand march in quickened measure. The assertion is made that during 1896 Nebraska will have a million acres of land under irrigation.

In pursuance of the general plan of the Northwestern Immigration Bureau, organized at the St. Paul convention, of which Washington and South Dakota are members, the two latter States have just held full and enthusiastic conventions and organized State bureaus, with branches in every county. North Dakota, Minnesota, Wisconsin, Montana, Oregon, Idaho and Manitoba, also members of the Northwestern Bureau, will take similar steps.

Wyoming did not make great headway during 1895, beyond her heavy coal production, but during the present year the prospects are that more gold and silver will be brought out. The depression has been seriously felt in her immense wool interests, but the righting of the protective tariff will eventually remedy all that, as it will also for the same interest in all the States. The cattle industry in Wyoming is a leading one, and the agricultural area is being much extended by bringing water upon new lands. Idaho has steadily advanced in mining and agriculture, and immense areas of arid lands are just now being opened up through irrigation. Montana maintained her old prestige in 1895 as one of the great min-

PROF. L. G. CARPENTER,
of Fort Collins, Colo.

Whom the Government of France honored with the decoration of Chevalier du Merite, Agricole.

PROSPEROUS TIMES FOR 1896.

BESIDES the usual spring flow of immigration to the far Western States and Territories, the coming season will witness the arrival of small armies of men to work in the gold mines. Capital has been attracted to these rich mining regions, and the diggings will be worked during 1896 as they were never worked before. This increased population must be fed, and there will be such a demand for supplies that more agricultural lands will be in request, and they, in turn, will be worked for golden crops.

An era of increased prosperity seems to have begun for this Western country that cannot be called a mere boom. It will be lasting and enduring, and all the industries will be built up while the work of mineral development progresses. Colorado will make further great strides during 1896, and her sister States will also push ahead. Investors in mining lands seem to be investigating the chances in all the States and Territories, and to be making choices in regions widely separated, and, for every mining district

ing States of the world and her agricultural advancement has also been great.

Nevada, for many years the leading mining State of the Union, will push forward again when transportation is cheapened, and when labor is adjusted on the scale of other States. During the past year an immensely rich gold district was opened up in the southeastern part of the State. Nevada's wool interest, which is very great, has been sadly crippled during the past three years of tariff insanity, and another of her great industries, that of horse raising, has been practically killed by the fall of the price of all ordinary animals of that breed. But good times will come again for Nevada.

Of California, like Utah and Colorado, and some of the others, there is hardly need to speak. She is still taking out gold, and her fruits and vegetables are everywhere to be seen. Texas is going into irrigation on a large scale and is becoming a great agricultural as well as a stockraising and mining country.

With her enthusiasm for irrigation, Kansas is going forward like a racehorse in agriculture, and she has got another new wrinkle. This time it is oil.

MANUFACTURES IN THE WEST.

IT is evident that the great woolen mills of the future will be in the West and Southwest, where the wool is grown, and that the East will lose the cotton manufactures in favor of the South and Southwest, where the cotton is grown. Notwithstanding the disastrous free trade of the past three years, several immense woolen mills have been completed in the far Western wool States, and, with a restoration of protective duties, a great new industry for this section will spring into life. Beet sugar has also come to stay. This industry will be given protection, and the acreage in beets and the number of sugar factories will increase in a more astonishing way even than during 1895. The quantity of sugar produced from beets in the United States is already greater than that produced from sugar cane, a fact not generally known. Tanneries are also increasing in number and these will be protected by the duties on leather. Indeed, the West and Southwest have come to see that a high protective tariff is neces-

sary along the whole line. Those Mexican cattle will be shut out, and so will timber and lumber from across the line. Liver-pool salt will be taxed out, and the salt industries of Utah, Wyoming, etc., will be given a chance to revive by the demand from the increasing number of packing-houses, creameries, etc.

Starch-making is now becoming a great industry in the Western and Northwestern States, great acres of land being sown to potatoes for the sole purpose of starch-making. Twenty new starch factories were in operation in Minnesota, North Dakota, South Dakota and other States during 1895. The number of canneries in the great fruit States was also largely augmented. It is positively stated that syrup can be manufactured from common corn-cobs and this will also be a new industry.

The Oscar Lake Syrup Association, near Alexandria, Minn., have a good outfit and are making a first-class article of syrup from sorghum and the yield goes about 170 gallons to the acre.

The completion and successful operation by the great flour-mill owners in Minneapolis of one of their mammoth mills at Great Falls, Montana, is a signal that the bread-producing region is moving westward. Of course, before a great firm of that kind would build a costly mill away in the interior, they calculated all the chances. To the amount of wheat which Montana can raise there is hardly any limit, and not many people realize how great a State Montana is, or what its slumbering resources are capable of producing. It is a better range State than Texas. It is one of the foremost mining States. And, if need be, it can be one of the first grain States in the Republic—that is for wheat, oats, barley, etc.

The contract recently made by the Oregon Railway & Navigation Company, making its line of steamers to the Orient permanent, insures a great trade in Oregon's flour with Asia. The manager of one of the leading flour mills of the State says their flour trade with Asia has doubled twice within the past three years, and he is confident it will be doubled again within three years. The arrangements at present are sufficient to handle 4,000 tons per month, and in two or three years at farthest, two steamers per month will be needed, instead of one, and the possibil-

ities of the trade in ten years no one can even approximate.

The hundreds of lumber and shingle-mills of Puget Sound are now in active operation, in spite of the apparent advantage of British Columbia mills in supplying our market,—which indicates that the American lumbermen either overestimate the advantage the Dominion government gives its loggers, or that the demand is great enough to prevent this advantage from closing American mills. The foreign demand for "Oregon pine," which means Washington fir, is good, and the harbors are full of ships awaiting cargoes for China, Japan, Hawaii, and the South American as well as South African ports. The output of shingles is heavy, the profit depending much on the experience and economy of the manufacturer.

NEW IRRIGATION ENTERPRISES.

P. P. SHELBY, assistant general traffic manager of the Great Northern, and other citizens of Seattle have organized a company for the purpose of developing the large waterless area along the line of the Great Northern between Wenatchee and Spokane. The plains stretching out in that region comprise more than 100,000 acres of land that is in every way desirable for farming, save that it has not an adequate water supply, and this supply is to be obtained by sinking artesian wells.

Following out the same general idea, still another company has been organized, with John D. McIntyre at its head. This company will operate in the neighborhood of Adrian, twenty-five miles further east on the line of the Great Northern, or 225 miles east of Seattle. The plan of this company is to put in a canal which shall gather up and utilize the water from Crab creek and several other creeks in the vicinity of Adrian.

An irrigating enterprise is being inaugurated at Strumpp's Rapids, six miles above Pasco, Wash., in the Columbia river, by J. E. Vangordon, Edward Clarke and J. C. Stelm, all citizens of Pasco and vicinity. They will irrigate 1,000 acres.

The first application for the setting aside of arid land to be redeemed under the Carey act in Idaho has been made by a big Wisconsin company, of which Charles

T. Palmer is president. The company has located at American Falls, on the Snake river, near Pocatello, and asks to have 100,000 acres set aside for reclamation under the Carey act. They propose to settle the entire tract with colonists, who will pay but fifty cents an acre for land and cost of water rights. The cost of irrigation works is estimated at \$200,000.

Secretary Smith, at Washington, took up and considered the bids for the irrigation work at the Fort Hall Indian reservation. He considered all the facts presented by the Commissioner of Indian Affairs, and his final conclusion was to authorize the commissioner to enter into a contract with the Idaho Canal company to construct the works at their bid of \$90,000 according to the government specifications.

The American Falls Irrigation & Power Company have applied for the control of 109,680 acres of land, located on Snake river, in Blaine county, Washington. The company proposes to take the water from Snake river, and carry it to the east to reclaim a large section of land that is now a desert waste. Another irrigation enterprise is to be put in next June, near Lewiston, Idaho. The company expect this project will cost \$10,000. This water will be procured from Asotin creek, and will be 1,000 miners' inches and when needed will be increased 2,000 miners' inches.

Wyoming papers say Chicago and Eastern cattle kings are conspiring to get hold of the 1,000,000 acres of land granted to the State under the Carey law, to the exclusion of the numerous small cattle owners and sheep owners, and every other industry. It is said that the cattle kings expect to get these lands under leases from the State.

Arthur P. Davis, hydrographer of the Geological Survey, has been detailed as an expert, at the request of the Indian bureau, to investigate the water supply and to plan a system of irrigation for the Gila River Indian Reservation, in Southern Arizona.

Several towns and cities in Oregon and Washington have lately obtained an excellent and adequate water supply in an inexpensive manner by the use of wooden pipes. The pipes are made from common pine logs, ten inches in diameter, hollowed

out with a six-inch bore. It is claimed that the wooden pipes last as long as the iron pipes. One town has a line of pipes seven miles long that, with all connections, cost but \$2,000.

Additional artesian wells are being bored in many parts of North Dakota, the water to be used for irrigation purposes. The city well at Mayville flows 9,000 barrels every twenty-four hours, and has already filled up a large lake in the park, the overflow going into Goose river.

Irrigation is making more rapid progress in Northwestern Texas than in any other part of the plains country at this time. Texas was one of the last to begin to experiment with irrigation but she has a wonderful supply of underflow waters and there is destined to be, within a very few years, some rich developments in agriculture in what has been almost a desert.

POSSIBILITIES OF BEET SUGAR.

That the people of Nebraska appreciate the value of the sugar beet is indicated by the fact that arrangements are complete for a State Beet Sugar Convention, to be held at Lincoln within a few days now. The Salt Lake Tribune says: "The wires tell us that Russia last year had under cultivation 814,419 acres of sugar beets and that the yield was 717,558 tons of sugar. That at 3 cents a pound gives Russia over \$40,000,000. Could that sugar have been raised in Utah, it would have been worth something over \$70,000,000. We do not need that much for Utah, but there is no possible sense, so long as this country is filled with idle men, in paying \$100,000,000 annually for foreign sugar. It is a sort of impeachment of our own intelligence."

Alameda county, California, did a very fair season's work in beet sugar, the quantity turned out by the sugar works at Alvarado being 5,400,163 pounds; tonnage of beets worked, 27,385. Acreage for next season in the county is 3,550.

The Chino Champion re-asserts that the average price paid for Chino beets last year was \$4.30 per ton; but the detailed figures of yield and amount paid for the whole, as given by the Champion, do not show that the price averaged above \$4 per ton.

Sugar was a somewhat short crop taken as a whole in 1895, compared with 1894. The total production for 1895 is estimated at 7,117,700 tons, of which 4,000,000 tons

are beet sugar, showing that the beet industry has already surpassed that of cane in the sugar output of the world. The shortage from 1894 is estimated at 1,225,000 tons, and 265,000 tons below the crop of the previous season.

Professor Hilgard of the University of California announces that there is absolutely no difference in the sweetening power of sugar made from sugar cane and beet root.

BIG OIL FLOW IN KANSAS.

The Standard Oil Company having purchased the Kansas oil fields, they are to be worked to their full capacity. Reports from Neodesha, in Southeastern Kansas, say: "The historic days of Oil City, Pa., are to be repeated in sunny Kansas. By the first of next week a still larger force of drillers will be on the ground and will average a rig a day until more than 200 new derricks will be added to the 120 now standing. Besides these forces of the Standard Oil Company, the Geiser Oil and Gas Company will soon have drillers at work, and, as stated by one of the companies interested, Southeastern Kansas will have 2,000 oil wells in less than six months."

The meeting of the Kansas State Board of Agriculture was largely attended and was, as usual, an event of great importance, the addresses, the papers read, and the reports of officers indicating the substantial advancement of the State. Irrigation is going forward with a rush. Extracts from some of the papers and reports are given elsewhere in this number. The officers elected were: President, J. M. Potter, Peabody. Vice-president, A. C. Shinn, Ottawa. Secretary, F. D. Coburn, Topeka. Treasurer, Samuel T. Howe, Topeka. New members, Joshua Wheeler, succeeds himself; A. W. Smith, succeeds himself; J. H. Churchill of Dodge City; I. L. Diesem, succeeds himself; George W. Crane, of Sheridan succeeds A. C. Shinn.

PRODUCTION OF GARDEN SEEDS.

A. G. Tillinghast, of La Cönnor, Wash., the pioneer seed grower of Puget Sound, shipped 800 bushels of cabbage seed to Eastern seedsmen in September.

In the Big Bend country of Central Washington, says the Spokane Review, an industry has been quietly springing up that is entitled to a great deal more attention

than it has been given. It is the growing of all kinds of garden seeds, under contract with some of the biggest seed houses in the world, these houses having found the soil and climate there the best in America for that purpose.

AN AGRICULTURAL REVOLUTION.

Several years of cultivation of Kaffir corn in Kansas have demonstrated that it is one of the most remunerative crops that can be grown under conditions existing in that State. That the farmers realize this fact is proven by the remarkable increase in the acreage shown by the reports of Secretary Coburn of the State Board of Agriculture for 1895. In 1893 the total Kaffir corn acreage was 46,911; in 1894, 95,237; and in 1895, 184,198.

There will be an agricultural revolution in Kansas this year. It will not only affect Kansas, but will spread all over the western half of Nebraska and Oklahoma. King Kaffir will contest every inch of an area equal to 105,000 square miles with King Corn, and the best judges of conditions prophesy that Kaffir will win.

MAKING ORANGE WINE.

At Riverside, Cal., a great building is now being erected for the purpose of working up the culled oranges into wine. There is always, even under the most favorable circumstances, a percentage of culls for which there has been no market at any price. The oranges are good, but, from some external defect, are not marketable. These oranges can be had at a very low price, of course, and any way of working them into marketable products, is, of course, so much clear gain. Redlands, Cal., will also have an orange winery.

NATIONAL IRRIGATION LEGISLATION.

The Secretary of the Interior recently sent to the Senate the report of the Board of Irrigation Executive Department. It was referred to the Committee on Irrigation and Reclamation of Arid Lands, and ordered printed, and copies of the pamphlet can now be had. The report is of the greatest importance to irrigation interests. It shows the progress of the Board of Irrigation, including a statement of its organization; the existing legislation relative to irrigation; the operations of the various subdivisions; the principle which should govern subdivisions, and the list

of official publications on irrigation. This latter list was given in detail in the January number of *THE IRRIGATION AGE*.

It is evident that the importance of irrigation is appreciated at the national capital, and that the Board of Irrigation is doing excellent work. Hon. Francis E. Warren, of Wyoming, who has been made chairman of the Senate standing committee on the subject, is the very man for the place, and that he will push forward all the urgently needed new legislation may well be expected.

ANNULLING LAND GRANTS.

The President has sent a special message to Congress urging the necessity for immediate legislation to extend the limit of time within which suits can be brought by the government to annul grants of public lands. He called attention to the numerous complications that had arisen between railroads as to grants that overlapped and the necessity for adjustment. The time in which suits can be brought expires March 3, 1896, and if the time limit were allowed to expire then a portion of the adjustment act would be rendered nugatory. The government, the President says, in conclusion, should not be prevented from going into the courts and righting wrongs perpetrated by its agents.

THE COAST SALMON PACK.

The salmon pack, spring and fall season, for the entire Pacific coast, was 2,034,877. Of this amount Alaska furnished 637,000; British Columbia 512,877.

NEW MEXICO OFFERS HOMES TO THE ARMENIANS.

Amadeo Chaves, territorial superintendent of public instruction for New Mexico, has addressed a letter to Edward F. Cragin, chairman of the Chicago executive committee to aid the Armenians, thanking him for his suggestion of colonizing these people in New Mexico and offering to supply the necessary land free of cost. Mr. Chaves considers Mr. Cragin's idea the happiest solution of the Armenian problem that has yet been advanced. He has looked into the character of the Armenians and regards them as a very desirable class of settlers. In Western Valencia county, along the line of the Atlantic & Pacific Railroad, Mr. Chaves has extended landed interests, and he proposes to place at the

disposal of the Chicago Armenian Association, free of cost, all the land they may desire to colonize, up to 500,000 acres. Or, if the committee deems best to locate the colonists on public lands, Mr. Chaves offers his services to enable the people to secure such locations.

A BUREAU OF LIVE STOCK INFORMATION

A memorial has just been presented to Congress which recites that the depression in the live stock industry of the West is due in a great measure to the indiscriminate way in which shipments are made to the four principal live stock markets—Chicago, St. Louis, Kansas City and Omaha. This memorial is signed by every Western exchange, and was forwarded by the executive committee of the National Exchange. It says there are no less than twenty-one States directly interested in shipping stock to one or more of the four markets mentioned, and that it is practically impossible for them to avoid glutting the market from time to time. The memorial asks Congress that some measures be provided whereby shippers can be informed (in an official and reliable way) of live stock receipts at these four centers from all of the twenty-one different States from day to day. If such a Bureau of Live Stock Information can be established, it will somewhat regulate the industry, and stock raisers and shippers will not be continually injuring their own interests and depressing the value of their own property.

WHY CATTLE RAISERS NEED PROTECTION.

Col. Albert Dean, agent of the Bureau of Animal Industry, has just received report of the number of cattle imported into the United States from Mexico for the month of November last. There were brought in from all points, 47,345. This is 1,645 more than the entire importation of the last half of 1893, as far as there is any record.

WASHINGTON IMMIGRATION ASSOCIATION.

The executive committee of the Washington State Immigration Association, just organized in the convention at Seattle, are: C. L. Webb, King county; A. S. Cole, Whatcom; E. G. Crawford, Clarke; E. J. White, Pierce; H. Bolster, Spokane; E. F. Benson, Yakima, and Harry Cornwall, Colfax. This committee organized by the election of C. L. Webb, president;

H. L. Bolster, Spokane, vice-president; and the president was authorized to appoint a secretary and treasurer. The committee earnestly recommended that an appropriation of not less than \$25,000 per annum should be made by the next Legislature for the promotion of immigration work.

THE WESTERN FRUIT INDUSTRY.

The Northwest Fruit Growers' Association includes Washington, Idaho, Oregon and British Columbia. The Bureau of Information recently organized has the following officers: President, W. S. Offner, Walla Walla; secretary, Willis Brown, Portland; directors, J. B. Holt, Wawawai; J. M. Gilbert, North Yakima; H. H. Spaulding, Almota; Emil Shanno, The Dalles. Headquarters are at Portland. Reports of the number of cars shipped to Eastern markets are to be received daily from all shipping points on the coast, including California, and then forwarded to local shipping points covered by the Association.

The Western Montana Fruit Growers' Association has been incorporated.

Colorado and New Mexico apples are breaking up the German apple monopoly in London. The Colorado and New Mexico product keeps better than the German. This year thousands of barrels will be shipped to England mainly by reason of a low rate lately obtained by growers, by which, in train load lots, apples can be exported from Denver to Liverpool at the same rate as from New York City.

The time is not far distant when England and quite a part of Western continental Europe will be supplied with fruit from the United States, and to quite an extent with fruit grown in the State of California and other Western States, where plums, nectarines, cherries, peaches, etc., are produced of a character that will bear transportation and delayed consumption with a not too serious deterioration in quality.

Stark Bros.' Orchard Bulletin remarks upon the great run given California fruit and vegetables in the Central, Western and Eastern States. It concludes an article with this: "Why not Ozark peaches and pears, adding Missouri or Arkansas, as the case may be, and why not Missouri, Illinois, Kentucky and Tennessee corn and tomatoes, as well as fruit? People of the Ozarks, Colorado and New Mexico are beginning

to wake up, and soon California will cease gathering all the cream."

A serious row regarding divisions on California freight traffic has just broken out between the Western Freight Association and the Southern Pacific Railway Company.

The bad treatment Western Fruit Growers and shippers get in Chicago has been the subject of much discussion of late in the annual meetings and at the Exchanges, and reform in this respect is demanded. Uniform, fair rates of transportation are also demanded. Cut rates and rebates to certain shippers only injure the general trade.

DEFAUDING THE SETTLERS.

A special detective from the Wisconsin district has been investigating the offices in the State of Washington in the guise of a litigant and reports that a cabal exists, composed of many prominent men in Western Washington, some of whose names are given, who are engaged in a gigantic scheme to steal public lands and defraud settlers, and that Receiver Hawkins' connection with them, innocently or otherwise, calls for his removal. Register Murphy is believed to have had no connection with this scheme.

WESTERN MEASURES IN CONGRESS.

The House committee on public lands has decided to favorably report the bill introduced by Representative Wilson, of Idaho, to give 25 per cent of the proceeds of mineral lands in public land States for the support of schools of mines.

"A Free Home bill," making actual residence on railroad land grants unnecessary where lands had been fenced and improved, has passed the House.

On motion of Mr. Bowers, Republican, California, a bill has passed the House authorizing the Secretary of the Interior, under regulations to be fixed by him, to permit the use of right of way upon public lands for the purpose of generating electric power.

A NEW ENTERPRISE.

The Pawnee Pass Reservation Company has filed a request with the State Land Board of Colorado, to be sent to the Secretary of the Interior to segregate 300,000

acres of land in Logan county for reclamation under the arid land law. The company is represented by R. C. West, of Greeley. The proposition of the company is to construct a reservoir to hold 1,500,000,000 cubic feet of water, which will be sufficient to irrigate 300,000 acres of land. The ditch which will be constructed will be fifty miles long.

A CORRECTION.

Editor IRRIGATION AGE: In your biographical sketch of me in your issue of *THE AGE* for January, there is one error which I desire to correct, as it might work an injury to an engineer of high standing and of whom I have the highest opinion. It is the statement that I had exclusive charge of the Jurupa Canal and Vivienda Pipe Line in San Bernardino county, California. While these works were being designed and constructed I was associated in business with Walter C. Parmley, C. E., now of Peoria, Ill., and his share and responsibility in them were equal to my own. I make this statement in justice to Mr. Parmley, knowing that you did not publish it intending to slight him, and because I do not wish any more praise than justly belongs to me. Mr. Parmley was associated with me in the practice of irrigation engineering from 1887 to 1889 and I am proud of this fact and the fact that all work done by our firm was highly successful.

F. C. FINKLE.

GOOD ROADS IN ILLINOIS.

At the ninth annual convention of the county supervisors and commissioners of Illinois, held at Kankakee, the convention was organized permanently under the name of the State Association of Supervisors, County Commissioners and County Clerks. The chair was authorized to appoint a committee of nine to present recommendations of the convention to the next General Assembly. A. G. Woodbury, of Danville, spoke upon "Roads and Bridges." He said good gravel roads could be built for \$1,500 a mile, macadam from \$1,800 to \$7,500. The passage of the Bogardus road bill was recommended; also that the road and bridge law be amended so as to increase the amount that may be levied from 20 cents on \$100 valuation to 40 cents.

MINES AND MINING OUTPUT

OFFICIAL ESTIMATES from the national capital do not correspond with the figures given out at the Western mining camps in regard to the production of the precious metals for the year just closed. It is announced from Washington that the Director of the Mint has received approximate estimates of the gold and silver product of the United States in 1895 from the mint officers and other agents employed to collect these statistics. The value of the gold and the number of fine ounces of silver produced by the several States and Territories is estimated to have been as follows:

Source.	Gold value.	Silver ounces. fine.
Alaska.....	\$ 1,500,000
Arizona.....	2,087,100	1,000,000
California.....	15,600,000	154,700
Colorado.....	15,000,000	22,000,000
Idaho.....	2,790,700	4,000,000
Michigan.....	40,000	85,000
Montana.....	4,392,700	14,500,000
Nevada.....	1,700,000	622,600
New Mexico.....	1,075,000	154,700
Oregon.....	2,200,000	7,700
So. Appalachian States.	316,200	1,200
South Dakota.....	4,255,000	82,200
Texas.....	206,000
Utah.....	1,352,300	8,223,800
Washington.....	300,000	11,600
All others.....	25,000	500
Total for 1895.....	\$52,614,000	51,000,000
In 1894.....	39,500,000	49,500,000
Increase.....	\$13,114,000	1,500,000

VISITORS were present on the opening day of the Chicago Mineral and Mining Board from all over the West, Colorado being especially well represented. The committees are going slow, and trying to be safe and sure, and thus far but fifteen stocks are listed, though many more are clamoring to be listed. Those already admitted are mostly Cripple Creek properties which produce and pay dividends. In his opening address President John Marder said: "The management desires to have it distinctly understood that the board is not limited to affording facilities for dealing in properties, stocks, bonds, and securities connected with the precious metals only,

but that especial facilities will be afforded for the presentation of coal, iron, copper, zinc, phosphates, and all other mineral properties, by bringing into immediate contact and intimate relations those who have mineral properties to sell or develop with those who have capital to make them productive."

TUNNEL-MINING is being resorted to more than ever in the Cripple Creek region. The laws of Colorado allow tunneling under other men's property. Tunnels are now being run under Gold Hill mountain, on which are a number of the great producing mines.

A WELL-INFORMED WRITER states that the best known plan and safest for the investment of outside capital in mining is the formation of a close corporation for the actual purchase, development and operation of mining property.

Stocks listed on the Chicago Mineral and Mining Board thus far are Isabella, Anaconda, Pharmacist, Portland, Union Gold, Favorite, Sleepy Hollow, Jefferson, Justice, Squaw Mountain, Finance and Rhyolite Gold.

THE values of the Colorado products for 1895 are claimed to be as follows: Gold, \$18,605,000; silver, \$14,259,049; copper, \$877,492; lead, \$2,955,114; coal, \$6,665,136; iron, \$1,586,200; steel rails, \$1,348,500.

JOHN MACKIN and John J. Philbin, Jr., of Chicago, have bought gold lands near Prescott, Ariz., within fifty miles of the locality selected by N. K. Fairbank, Marshall Field, and Lyman Gage.

REPRESENTATIVES of all the mining exchanges of the West are attending the opening of the New York Exchange. A big excursion train was run from Denver.

THE Mechem Investment Company have opened a mining exchange in the Western Union Building, Chicago, confining the lists wholly to Colorado properties.

MINING PIONEERS AIR THEIR VIEWS.

REUNION OF CALIFORNIA VETERANS IN CHICAGO.

A MOST enjoyable occasion was the recent seventh annual business meeting and banquet, in Chicago, of the Western Association of California Pioneers. The organization was effected in 1890 through the efforts of Charles P. Jackson, Addison Ballard, H. A. Eastman and others, and there are now 143 members. Chicago is rapidly becoming a great mining center, and, with the influx of mining men, it is likely that the membership will be largely increased. The reunion was held in the club-rooms of the Sherman house. At the business meeting the following officers were elected: President, Addison Ballard; first vice-president, Candam Knight; second vice-president, G. G. Curtis; treasurer, G. G. Pope; secretary, G. W. Hotchkiss; trustees, Joseph Clark, Israel Sunderland, Thomas Mahew, John Kinsey, J. A. B. Walker.

Among the members present were M. Parkins, George G. Custer, E. G. Crane, J. A. B. Waldo, W. E. Reed, S. P. Blodgett, L. M. McEwen, T. P. Sears, John B. Kerr, Addison Ballard, H. W. Emery, J. H. Smiley, G. W. Hotchkiss, J. C. Gault, John Kinsey, G. E. Strong, H. Latham, Thomas Mahew, J. A. Macomber, J. F. Thompson, William Johnson and others. Benjamin R. Nickerson, of Chicago, eighty-five years of age, is the oldest member. He is the only surviving member of the first California Legislature.

The decorations about the banquet room were of golden hue, as also those on the tables, and old-gold badges were worn by the veteran miners. A more hardy, better preserved, better informed or more jolly set of men has not come together in Chicago for many a day. All are wealthy, and most of the gentlemen are still in active business. As seen by the names, several are still prominent in politics, as well as business, in Chicago.

This annual reunion is held in commemoration of the discovery of gold in California, which occurred January 24, 1848. September 9 is also a day of celebration, as it marks the admission of California into the Union in 1850.

Alderman Ballard was toast-master, and he used a handsome gavel made from the

wood of the hanging tree at Hangtown and Sutter's Mill, near which the first find of the yellow metal was made. There were no regular toasts, the time being occupied in discussing the good things on the menu, and in exchanging reminiscences and making speeches on the days of '49, when the California gold fever was at its height, as well as the days of Pike's Peak, and the new finds of today. "What was missed at Pike's Peak," in Colorado, by the armies of men who toiled about there in 1859, was dwelt upon by members who were there at that time. The Cripple Creek of today is down the southwest slope of Pike's Peak, near its western base. In 1859 men froze to death and died of starvation right in the neighborhood of where the new Cripple Creek diggings are today.

George Custer made the Western trip in 1850. He told graphic stories of the hanging tree at Hangtown. After being in California for some time he returned to "the States," with his father by way of the Isthmus of Panama and New York. It was in 1849 that Mr. Ballard went to the California gold fields, and the trip consumed six months. Chicago then had no railroads. He returned in 1852. Mr. H. A. Eastman went by way of the Isthmus and remained ten years. Mr. Parkins (of Mendota, Ill.) went West in 1849, using a team of oxen, and the trip out was made in five months. In his party there was a long train of "prairie schooners." Mr. E. G. Crane, a cousin of Congressman Hopkins of Aurora, walked all the way to Pike's Peak in 1859.

After the reminiscences came discussions on the great progress of the West, what irrigation was doing for its development, the admission of Utah, and the bills in the present Congress for the admission of Arizona, New Mexico and Oklahoma. That ex-President Harrison had just made argument in the United States Supreme Court in favor of the California (the Wright) Irrigation District Law was regarded as conclusive that one great constitutional lawyer was willing to risk his reputation at a most critical time that the said law was constitutional.

THE EDITOR'S DRAWER

A CHICAGO combination will reclaim 10,000 acres of land in Idaho.

BLOOMING UTAH, the forty-fifth star, is welcome as the flowers in June.

COLORADO has a great opportunity just now to market her agricultural lands.

CHICAGO is becoming the mining center of the whole North and West—iron as well as the precious metals.

CONNECTICUT leads New England in resorting to irrigation and all the other States are falling into line.

THIS Congress will possibly submit its differences on tariff and silver to arbitration—arbitration at the polls.

THE great salt springs and salt beds of Wyoming are abandoned because of the cheap imported Liverpool salt.

ONE sure way of securing new settlers is to secure new railroads and railroad extensions, and through connections.

SECRETARY MORTON opposes the use of public money in solving irrigation problems in the West. But that gentleman will not be in office forever.

THE great growth of manufactures in the far Western and Southwestern States within a year past is astonishing. Notwithstanding the tariff insanity, even woolen mills are among the industries.

ALL through the central Western States and the East and South, and also in Canada, the agricultural press has taken up the subject of irrigation, a fact that is most flattering to THE IRRIGATION AGE.

WHICH State or Territory wants the printers' colony? The many printers (or ex-printers) conferred with seem to prefer New Mexico. They will make good citizens and, with their intelligence, must become scientific farmers.

WASHINGTON and South Dakota have already followed out the plan of the Northwestern Immigration Bureau and organ-

ized State bureaus, with branches in each county, and the other States in the north-western organization will do likewise.

It is now suggested that Wyoming, Colorado, New Mexico, Utah, and Arizona, organize a great immigration bureau after the style of the one organized at St. Paul.

THE Illinois Farmers' Institute urges the farmers of the State to make a special effort to secure the election of such members of the Legislature as will make laws to equalize taxes on farm property with those on other property.

H. V. HINCKLEY, Mem. Am. Soc. C. E., has been appointed by the commissioners of Shawnee county, Kansas, to have charge of the Melan bridge to be built in the City of Topeka. It will be the largest Melan bridge on the American Continent.

HON. F. D. COBURN was re-elected secretary of the Kansas State Board of Agriculture by a rising vote, a compliment well deserved. The farmers of the State, and people in all occupations, well know and duly appreciate Mr. Coburn's great services.

It is a question whether the Standard Oil Company has gobbled up the Kansas oil fields or vice versa. Anyway, operations have begun and it is predicted that the exciting scenes of Oil City, Pa., and thereabouts are to be repeated in South-eastern Kansas.

THE fact of the possibility of such an association of associations—such a federation of interests—as the National Association of Manufacturers of the United States is in itself one of the signs of the times. Congress will never be allowed in the future to disturb and injure the business of the whole country.

AS EXECUTIVE committee of the South Dakota State Immigration Board, the following gentlemen were elected: F. W. Morris, of Tripp; T. H. Brown, of Sioux Falls; S. N. Narregang, of Aberdeen; J.

M. Greene, of Chamberlain; A. J. Lockhart, of Clear Lake; J. H. Baldwin. F. W. Morris was elected president, S. W. Narrengang secretary, T. H. Brown treasurer.

PRAIRIE FARMERS in the central Western States are all preparing to have irrigation reservoirs, and for more reasons than one. They want food fish, and they also want a supply of pure ice for the hot months of summer.

THE fruit growers of California, New Mexico, Colorado, Washington, Idaho, and Oregon, have thoroughly organized and they ask justice from the railroads and from the Chicago commission men. They have not been fairly treated by some of the Chicago dealers.

NEW mining legislation will likely come from Washington which will greatly simplify matters. An attempt will be made to pass a law requiring that there shall be no workings beyond the width and length of each claim, doing away with the present method of following leads.

To an interested observer it would seem very much as if those exhibition trains through the central West and East did just the opposite to what was desired. Instead of prompting farmers to change their locations, the splendid crops exhibited suggested to them that they could remain at home and irrigate their present holdings.

CONGRESS must throw safeguards about those 1,000,000 acre land grants to the Western States and Territories. The cattle interests should be considered, of course, but it is openly charged that Chicago and Eastern so-called cattle kings are laying plans to gobble up these lands under long leases from the States and Territories.

THE fifteenth annual meeting of the American Forestry association was held at Washington recently. The main object of the gathering was to secure the enactment of a law for the proper administration of the forest reserves in the United States, which aggregate 17,564,800 acres, and to secure the protection of the forests on public lands.

A "POPULAR LOAN" is somewhat better than a deal in which a syndicate gathers in millions, but the necessity for a "popular loan" and the loan itself are to be deplored. Of course numerous banks will suspend payment rather than let the people withdraw their deposits to invest them in bonds. Money in the banks is really money in circulation in business enterprises.

BI-METALLISM seems still to be going to the front. In his speech at Columbus, Mr. Foraker, the new Republican Ohio senator, outlined his policy as favoring protection to home industry and also bi-metallism. He believed the world made a mistake when it demonetized silver, and "sincerely hopes that some safe way may be found for the restoration of silver to its rightful place alongside of gold as a money of ultimate redemption."

At the annual meeting of the Western Society of Engineers, in Chicago, officers were elected as follows: President, John F. Wallace, chief engineer of the Illinois Central; first vice-president, Thomas T. Johnson of the drainage board; second vice-president, Alfred Noble of the Nicaragua Canal board; secretary, Charles J. Roney treasurer, E. Gerber of Morrison & Gerber, engineers; trustee, Horace E. Horton, president of the Chicago Bridge Company.

If Western and Northwestern farmers see fit to risk themselves and their families south of Mason and Dixon's line, well and good. It may be truthfully stated, however, that the survivors of colonies which went South from the Northwest two and three years ago, and who have just managed to get back, tell most dismal tales. They insist that only negroes can work in that climate. They say also that in many cases it was impossible to perfect the titles to land.

THE comparative small cost of irrigation in Illinois and the other central Western States, as shown in the January number of *THE IRRIGATION AGE*, seems to have astonished the farmers. Further information on the subject is given in this number. The irrigation fever is an epidemic that is sweeping in every direction, especially in this State, Indiana, Michigan, and Wisconsin. Experiments are also being made in Missouri.

TOPICS OF THE TIME

Defrauding the Settler. The one most important matter to be considered in purchasing Western lands is the water supply for irrigation. On the correct answer to this depend the welfare and prosperity of the settler. Climate, fertility of soil, transportation facilities and nearness to markets are of no avail if the water supply is inadequate. The practice, so common among a number of land and irrigation companies, of selling water rights when they cannot deliver the water, is outrageous and it is working injury to every Western interest. The prospective settler looks with distrust upon every proposition because he has heard of some one who has been deluded and swindled by purchasing land and water upon promises made but to be broken and by having conditions falsely represented. The water supply in the streams has in many cases been over-appropriated and the settlers who have purchased and paid for the water in good faith suffer for the sins of others and are a prey to the extortion and greed of the reckless money grasping company. This condition of affairs is a positive detriment to the entire West and especially to those individuals and companies who are doing a legitimate business and dealing fairly with their patrons. THE IRRIGATION AGE proposes to take a stand on this question hereafter and it will work for the best interests of the honest land company and the prospective purchaser.

The West is Waiting. There is a general desire that a national commission be created to regulate the distribution of irrigation waters in the West, and in the country generally, for it is evident now that the sure mode of farming is to obtain on an extensive scale, in all sections of the country. Something looked for a long time ago was a decision by the United States Supreme Court of the question before it as to the constitutionality of the Wright District law in California, but it is not yet forthcoming. The district laws in other States being

about the same, this decision will have equal application. While this legislation and court business is pending there is of course uncertainty, and the rapid progress of development in Western America is much retarded. The people of the country are growing very tired of the political pulling and hauling at the national capital and would like to see Congress get down to business.

The Coming Discovery. How innocent of those commissioners authorized by Congress to choose a deep waterway connecting the lakes with the Atlantic ocean! Interviewed at Detroit, they "have not the least idea, as yet, what route may be chosen." Well, here's a guess: Chicago is spending about \$30,000,000 building a "Drainage Canal." When this is completed there will be only a short strip between the end and the Mississippi river. In other words, here is a deep waterway already about built. What more natural than that the commissioners may "discover" this canal and recommend that the government complete the waterway to the Mississippi, thus connecting the lakes and the Atlantic ocean? Why, gentlemen, whether you know it now or not, that was the sole purpose of the creation of your commission. Come to it, you must. The South and West will push this through Congress in spite of all Eastern opposition.

America for Americans. Free wool has brought the Pacific coast sheep raisers to the verge of ruin, and the practically free importations of Mexican cattle would eventually put the cattle industry in the same ship. But all that will be regulated by and by.

It is asserted and reiterated for the farmers (not by the farmers) that a protective tariff does not benefit them in the least—is rather against their interest. It was promised that the Wilson free trade law would enlarge the markets of American producers, thus benefiting them, but

as a matter of fact it has injured the farmer, and the manufacturer as well. Here are some official figures: During the first nine months of the Wilson law in 1895, the imports of agricultural products, including live stock, breadstuffs, eggs, flax, feathers, fruits, hay, hides, hops, provisions, rice, seeds, tobacco, vegetables and wool amounted to \$85,256,219 against an importation of the same products of \$55,840,848 during a like period of the last year of the McKinley tariff, showing a direct loss to American farmers of \$29,415,371. On the other hand, the exports of the chief agricultural products showed a decline of \$23,787,180.

Irrigation and Mining. At the close of a calendar year the agricultural, commercial and industrial progress of a section can be figured up. The live and aggressive press of Western America has done its figuring for 1895, and the results are astonishing. Irrigation has done wonders, these wonders have attracted attention to the West generally and to the hidden wealth of the earth in particular. Investors have been attracted to the mining properties, and they are to be worked during 1896 as never before. There will be armies of immigrants in the spring, and the development of the mining and agricultural resources will go forward with a rush. Now is the time for the various States and Territories to let this country and Europe know fully the merits of their agricultural lands. The Northwest Immigration convention at St. Paul, and the Washington and South Dakota State Immigration convention were most timely, and cannot fail of good results. Each State and Territory, however, should have an immigration bureau East, with branches at the seaports and also in the great central cities.

Prosperity and Advance. The first, last and best indication of a country's prosperity and advancement is the appearance of its newspapers. On Christmas and on New Year's Day all the Western and Pacific coast papers issued specially prepared numbers, which were models of excellence and beauty; but it is the common every-day issues that are alluded to here. They are full of local news, have copious telegraph dispatches from all

quarters in this country and abroad, are ably edited and, in typographical appearance, are the peers of the press anywhere in Christendom. Western America also has its own magazines, illustrated to perfection. There is no longer any "rowdiness" in Western literature. Rare good taste is displayed by the editorial management, and the manners of this literature are the most metropolitan.

Most Bitter Experience. The immense corn crop and the consequent low value, and the hog cholera with its great losses, will doubtless force upon the minds of central Western farmers the urgent necessity of diversifying their operations. One or two specialties cannot be depended upon. With, at least, a small patch of orchard and garden irrigated (to be dead sure on), and a diversification of operations generally, giving some attention to dairy and poultry, no farmer can be wholly stranded, as thousands have been the past season. Many men who have heretofore paid their whole attention to stock raising will do something in agriculture on the side during the coming season. If the affairs of the State granges were systematized and reports required from each member, it would seem within the range of possibilities for each farmer to be notified before planting time of the total average contemplated for at least corn and wheat. The extension of the corn belt and the advent of cotton seed must be taken into all calculations. It seems likely that Mr. P. D. Armour will rake in millions of dollars through the mistakes and disasters of 1895.

Investigating the Department. Notwithstanding the recent "iron-clad" ruling by the Department of Agriculture that packers could no longer use any name for their oleomargarine that is "suggestive of the dairy," it is alleged that a permit has been obtained from the department by the Kansas City Armours which will allow them to continue to stamp and label their bogus stuff "Silver Churn." The dairy interests are asking what such conduct on the part of Secretary Morton means, and urge that, with this permit the recent ruling cannot be consistently enforced against other packers who stamp a milch cow or a churn on their bull butter.

FISH AND ICE ON IRRIGATED FARMS.

PUMPS AND RESERVOIRS EVERYWHERE.

IT is not at all surprising that farmers in the central Western States are all determining to irrigate strips of orchard and garden patches, even if they can do no more immediately. They want the reservoir because it not only makes the crops irrigated *certain* and *four to six fold greater*, but it furnishes *fish*, and during the winter, *a supply of pure ice can be cut that will last all the next summer*. The solution of the ice problem alone on prairie farms is a great feature.

That the reservoir is within the reach of all is indicated beyond a doubt by the figures of M. B. Tomblin, of Kansas, on windmill irrigation on the plains. He says: "My windmill plant consists of a five-inch tubular well, operated by a sixteen-foot steel back-gear wheel, built expressly for this kind of work. The reservoir into which the pump discharges is eighty-two feet in diameter at the base, inside measurement. The walls are six feet high on the outside. The bottom, as well as a strip about eight feet wide under the walls, was thoroughly puddled, and the reservoir seems to hold water perfectly. In a good wind the pump discharges about twenty gallons a minute. Everything connected with the pump and windmill is of the most solid and substantial character. A much lighter and cheaper plant could have been purchased, and would probably have done the same work, for a time at least, but the fact that the mill is turned loose to the wind at all times, stormy as well as fair weather, and has cost me less than one dollar for repairs during a year, and today is apparently as good as ever, convinced me that I made no mistake in choosing the very strongest and best material throughout. The plant cost a little less than \$500.

"When a farmer can do a great share of the work himself, such as building the reservoir, helping the wall men, etc., the cost can probably be reduced \$100. The tract selected for my experiment was a seven-acre orchard of young trees, and a three-acre plat adjoining."

After reciting the great success of his crops of vegetables, the writer adds: "My reservoir was stocked with fish and now affords me a much better article than the market supplies; another year I can take from it a thousand pounds of fish and still leave it as well stocked for the following year. The reservoir will afford me 100 tons of ice this winter, furnishing an abundance for my own use, and some to sell to my neighbors."

OFFICIAL FIGURES are also at hand from Hon. J. H. Baldwin, State Irrigation Engineer of South Dakota, which will prove of importance to new beginners in Illinois and other central Western and Eastern States: He says: "Here in South Dakota we have two distinct classes of artesian wells, one of which is deep and the other termed shallow wells, and many people not acquainted with the condition are often misled as to the value and difference. These shallow wells are being put down in great numbers and are not expensive, yet they are very valuable both for stock and general domestic uses and for irrigating small tracts of land. The cost of these shallow wells runs from \$100 to \$300 as a rule, yet some cost even less. The depth varies from fifty to 300 feet. There are over 300 of this class. Of deep wells, there are about 150 in active operation. The depth varies from 500 to 1,500 feet and they cost, with everything complete, about \$300 per foot. A first-class well will furnish 600 to 800 gallons per minute. The water properly served up and handled will supply 2,000 acres. The number of new wells that will come in use next spring and summer depends on the ability of townships to negotiate their bonds."

No act of the Kansas Legislature of 1895 received more commendation in the State Board of Agriculture at its recent session than the one providing for the State Board of Irrigation and the appropriation of funds to carry on experiments.

In D. M. Frost, of Garden City; W. B. Sutton, of Russell, and M. B. Tomblin of Goodland, Governor Morrill selected excellent timber for that Board, and the review of its work, thus far, by Secretary Sutton, speaks volumes. President Potter and Secretary Coburn of the State Board of Agriculture were both re-elected.

arrangements to have the wheel manufactured there and at Rockford, Ill. Sold wheels and mill machinery until 1886 in partnership with R. B. Flenniken of Colesburg, Iowa. In that year Mr. Flenniken retired and later on Mr. Frank Williams, of Moline, Ill., took his place in the partnership. Commenced the manufacture of flouring mill machinery about that time on a small scale in rented rooms in Iowa Iron Works and later on in Novelty Iron Works. In 1891 the business had outgrown the limited facilities for manufacturing and a stock company was organized and the present shops of the company were erected.

T. W. GRAHAM.

A WESTERN MANUFACTURER.

T. W. GRAHAM, President of the Dubuque Turbine & R. M. Co., was born at Rutland, Vermont, February 21, 1848; moved to Iowa with parents in the spring of 1854. They settled in Clayton county, Iowa, and engaged in farming and saw-milling. He was educated at the country school; got the Western fever in 1871; went to the Kansas frontier; pre-empted a quarter section of land and made some improvements thereon. The experience of the few years following with grasshoppers and fever and ague persuaded him to return to Iowa. In 1875 he went to work in a mill owned by an uncle at Rockford, Iowa; learned to dress burrs and grind. He also worked some at mill-wright work, building flour bolts and elevators under his uncle's directions. He worked at carpenter work and mill-wrighting until 1881, when he bought a one-half interest in the Flenniken water wheel. Went to Dubuque and made

A WITTE PORTABLE GASOLINE ENGINE. GASOLINE ENGINES.

The above is a cut of a twenty-five horse power portable gasoline engine, recently shipped to Southern California by the Witte Iron Works Company, of Kansas City, manufacturers of the Witte gas and gasoline engines. In that country where water is scarce gasoline engines are the popular power and the county to which this one is shipped alone has 1,600 in use. The many advantages the portable gasoline engine possesses are readily perceived. No water to haul, fuel for a week's run easily carried, and no danger from *flying sparks*. For irrigating, the pump is placed on the trucks with engine, thus making a compact outfit very easily handled. Every farm and ranch of any size should have some such power for grinding feed, pumping water for stock, and especially in the West for irrigating. The Witte Iron Works Company make these portable engines in sizes from one and one-half to fifty horse power, and, while they make them for sale, would be pleased to correspond with parties who, if unable to purchase an entire plant,

would like to have their farms irrigated for so much per acre. For full information write them, and mention THE AGE.

AN IRRIGATION EDITION.

"Every Farmer or Gardener interested in Irrigation should send 5 cents in postage stamps to The Dakota Farmer, Aberdeen, South Dak., and get a copy of that paper dated November 1, and which was devoted entirely to Irrigation and the Greatest Artesian Basin in the World. It is profusely illustrated and is one of the best special issues which we have seen this year."

THE LATEST, BIGGEST AND BEST THING OUT

The new 160-page finely illustrated Poultry Guide, Poultry Doctor and Combined Incubator and Poultry Catalogue of the Reliable Incubator and Brooder Company, Quincy, Ill., for 1896, is a superb publication. It is a book which should be in the hands of every wide awake up-to-date progressive poultry raiser. This Guide tells a great deal about the profits on poultry; about feeding, especially for eggs; about Pekin Duck farming; about the characteristics of twenty five leading varieties of fowls, ducks, geese and turkeys; about killing, dressing and shipping market poultry; about the common diseases of poultry; about hatching eggs with machines; about brooding chicks without hens; about building incubator cellars, brooding houses, etc.

The Reliable Incubator presents in this Combined Guide and Catalogue a complete line of New-Style, Latest-Improved, Self-Regulating Hot-Water and Hot-Air Incubators, In Door and Out-Door Brooders, Sectional Brooders, Brooder House Heaters and poultry supplies of all kinds; also original, copyrighted illustrations by Sewell of the sixteen popular varieties of thoroughbred fowls which they breed and

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have for sale, together with several full page views of the Reliable Poultry Farm, the largest thoroughbred plant in America. They ask one dime, ten cents, in silver or stamps for this 160-page book, to keep merely curious people from sending for it. If you mean BUSINESS this Guide and Catalogue is worth one dollar to anyone engaged in raising poultry for profit. The book is now ready for mailing. Address the RELIABLE INCUBATOR & BROODER Co., Quincy, Ill., mentioning THE AGE.

WHEN THE CLOUDS ARE IN THE BLUE.

You may say that life is trouble
When the clouds are in the blue;
But a fellow finds it double
When the
Note

Falls
Due!

Sorrow's nothing but a bubble
That will vanish from the view;
But it's trouble, trouble, trouble,
When the
Note

Falls
Due!

And the corn—it goes to stubble,
And the rose—it withers too;
And it's trouble, trouble, trouble,
When the
Note

Falls
Due!

Go it single file, or double,
There'll be work enough for you
In a living world of trouble,
When the
Note

Falls
Due!

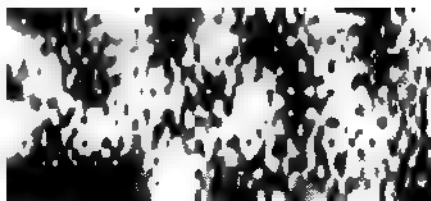
F. J. Stanton in *Atlanta Constitution*.

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LAND GRADERS.

We have received from Mr. B. F. Shuart, of Oberlin, Ohio, a newly issued circular descriptive of the improvements which, in response to the demands of patrons, have recently been made in his Steel-Improved Land Grader, advertised in this magazine. Originally designed to meet the needs of irrigators, simply, this machine has proved itself adapted to a much wider range of possibilities, and is being sought after by road-builders and contractors in earth as the most satisfactory and efficient appliance available for a great variety of purposes involving accurate grading. The machine is now made in three different styles. The testimonials are from widely scattered sources and accord to the grader a high degree of merit.

Mr. Shuart also sends us a copy of his article on how to start alfalfa, which appeared in *The Age* for September, 1894. Thousands of copies of this circular have been gratuitously distributed, and Mr. Shuart writes that he has received numerous letters from alfalfa growers in California, Nebraska and other States thanking him for having put them into the way of complete success after repeated experiences of failure. We advise our readers, who may be interested, to write to Mr. Shuart for these circulars.

Feeling the need of medicine the other day, Pat applied to a doctor with whom he was acquainted. Medicus asked the symptoms, felt the pulse, examined the tongue and did whatever else professional etiquette demanded. Then he said:

"Patrick, you're run down a bit, that's all. What you need is animal food."

And Pat departed quite contented. About two days afterward the doctor happened to think of his case, and called on Pat in the stable.

"Well, Pat," said he, "how are you getting on with the treatment?"

"O, shure, sir," said Pat, "Oi manage all right with the grain and oats, but it's dommed har-rd with the chopped hay."

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No. 3

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"	15	1 $\frac{1}{4}$	1	6 " 12	5	5	150	55 00	70 00
"	20	2	1	8 " 16	7	7	200	60 00	75 00
"	25	2 $\frac{1}{2}$	1	10 " 24	11	11	225	66 00	81 00
"	30	3	1 $\frac{1}{4}$	18 " 35	15	15	250	75 00	90 00
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THE IRRIGATION AGE.

VOL. IX.

CHICAGO, MARCH, 1896.

NO. 3.

WATER SUPPLIES FOR IRRIGATION.

III. MEASUREMENT OF STREAMS, GAUGING THE UNDERFLOW.

BY F. C. FINKLE.

RAINFALL is variable in all countries. At times a storm occurs when as much water falls in the space of a few hours as during all the balance of the year. Again, certain seasons are subject to frequent and heavy storms, while others are wholly, or almost so, devoid of rainfall. This marked division of the year into a dry and a wet or rainy season is particularly the case in countries where irrigation is necessary, and as has been already shown, is one of the principal causes which make irrigation a necessity in such districts. The natural streams, being fed by the fall of rain on the watersheds tributary thereto, will vary in their discharge as the season is dry or wet. During the wet season, when rains are heavy and frequent, the streams will rise and flow large quantities of water, which cannot be diverted and used for irrigation, as the water is not needed at that time of the year, the ground being already saturated by the natural rainfall. The only manner in which this storm flow can be utilized is by storing it in reservoirs, and thus conserving it until the dry season; this subject will be subsequently treated under the head of storage reservoirs.

At present our discussion will be on the value of natural streams for irrigation purposes during the irrigation season, when the flows of streams are at their minimum.

Before an enterprise is founded with the natural flow of a stream as a water supply, it is necessary to make a careful determin-

ation of the minimum discharge of the stream during the season of irrigation. As soon as the extent and character of the watershed which feeds the stream is known, we are able to judge approximately of its value as a source of water supply. A flowing stream derives its supply of water during the season of no rains either from melting snows or from springs. Both of these are the accumulations from the season of rains, and to what extent depends on the area, elevation and nature of the watershed.

If the watershed is large and high it will contain a plentiful quantity of snow at the end of the rainy season, which by reason of the coolness of the atmosphere at a high elevation, will have fallen, and will gradually melt during the dry and warm season following, thus feeding the stream flowing from it.

Again, if the watershed is composed of loose and impervious layers, intermingled in such a way as to create underground basins and channels, which accumulate the water and again conduct it to the surface later in the season, the stream to which it is tributary will be fed by springs. In these two ways, viz., by melting snow and springs, the streams are supplied with water during the dry season, and understanding these principles we are able to judge somewhat of the capacity of a stream for supplying water for irrigation, as soon as we have become acquainted with the characteristics of its watershed. But it is

impossible to know the exact ability of a stream for supplying water unless it has been gauged or measured for a number of years during the season of minimum flow.

METHODS OF MEASURING.

There are a number of methods in use for determining the flow of a stream of water confined in a fairly well-defined channel of its own. Sometimes the result is attained by determining the mean velocity of the flow and measuring the area of cross-section occupied by the flowing water, while at other times it may be more convenient to erect a measuring weir, and by the use of a weir formula determine the rate of flow.

If the former of these methods is used, the velocity may be determined by a current meter, or the slope and cross-section may be measured and some suitable formula for the flow of water in open channels employed for calculating the result.

Circumstances must govern an engineer almost wholly as to which method he should employ. In the case of a stream, which is neither too large nor too rapid to prevent the construction of a measuring weir across it at a reasonable expense, this is the best method to adopt, as the result obtained is invariably more accurate than by any other method. On the other hand, when a stream is either too large or swift, or cannot be easily controlled over a weir for some other reason, it is better to determine the velocity of the water and the area of cross-section it occupies, and let the result depend on these determinations, rather than to attempt the more expensive expedient of constructing a measuring weir.

The details and formulæ for measuring the flow of streams will be fully discussed in succeeding chapters devoted to the flow of water in open channels and over measuring weirs.

UNDERFLOW OF STREAMS.

All the water supply of a river or creek is not always visible on the surface of the ground constituting the bed of the stream. Sometimes a large proportion of the water flows under the surface of the ground entirely and is not visible, giving no ocular evidence of the existence of more than that which flows in the channel of the stream. Again, the entire flow of a stream may exist under the surface of the bed and no water be visible at all, except during pe-

riods of storms and freshets. Such streams are usually called "dry creeks," the fact that no water is in sight being taken as conclusive evidence that the water-courses in question possess no permanent and regular water supply.

But in regions where water is scarce, either for domestic or irrigation purposes, explorations have been made below the surface, which have demonstrated that an underflow exists under the channels of most streams whether there is any surface flow or not. Such underflows have not only been often discovered, but in many cases have been fully developed and are now being used as a permanent source of water supply for domestic and irrigation water systems.

The character and extent of the underflow of streams is in a great measure controlled by the same conditions which govern the surface flow, and must be investigated and analyzed in much the same manner. The same information in regard to rainfall, watershed, etc., which has already been discussed in the preceding articles in connection with the surface flow of streams, must also be collected and used in investigating the underflow of a stream as a source of water supply for irrigation. In addition there are many other subjects to be considered which will be discussed in the succeeding articles.

DEFINITION OF UNDERFLOW.

The underflow of a stream is water derived from rainfall descending upon the watershed tributary to the stream, which sinks into the ground until intercepted by the first impervious layer encountered and then percolates through the coarse material composing the bed of the stream in practically the same direction as the surface drainage. The above definition covers all the points which distinguish an underflow and enables us to identify it as such.

It is clearly distinguished from artesian water, which also originates from rainfall entering the ground before it reaches the channel of a stream, but is confined between two or more impervious formations, and is usually found at a considerable distance from the point where it first sinks, in the fact of its existence on top of the first impervious stratum encountered after penetrating the loose material of the channel, and in being devoid of pressure

sufficient to force it to the surface when the ground is penetrated by borings. It also differs from subsoil or surface water, which sinks from the rainfall and fills the voids in the subsoil, in the fact of its possessing motion or velocity caused by the slope of the water-bearing stratum and the pressure of water on a higher plane gravitating downward and tending to displace the particles of water on a lower plane.

EXISTENCE OF UNDERFLOWS.

There are many streams which do not possess any underflow of water, on account of the absence of such conditions as are necessary to produce one. The existence of an underflow is by no means an invariable accompaniment of a river or creek, but is possibly lacking in more cases than it is present. An underflow is also frequently found where there is nothing more than a dry wash to indicate the existence of a channel, which carries water only in times of extraordinary floods or cloudbursts.

The conditions required to produce an underflow in a stream are the following: (1) A suitable watershed; (2) a favorable surface topography; (3) sufficient and properly distributed precipitation; (4) proper character of channel and surface formation; (5) a hard substratum.

The above five heads cover all the conditions necessary to create an underflow of some importance in a stream, and by means of a thorough understanding of these it is possible to form an opinion on the existence of an underflow in any stream, after becoming acquainted with the natural characteristics of the stream and its drainage area. The discussion of the requirements above enumerated is a matter of importance, and while the articles on each topic will be brief, it will be the aim to cover the subjects so as to include all that is very essential.

SUITABLE WATERSHED.

A watershed must be of ample size to create the existence of any considerable underflow in the stream which drains it. But size is not the only or most important consideration, as a watershed of fifty square miles or even less has been known to furnish a goodly amount of underflow, where other conditions were favorable. On the other hand it often happens that a very

large watershed creates no underflow at all, on account of being lacking in other respects.

A high watershed is very desirable, as the cool air at high elevations is a good condenser of the vapor in the atmosphere, and this serves to increase the rainfall. Besides, if the elevation is sufficiently high to cause a large portion of the precipitation to fall in the form of snow, this is a considerable advantage, as will be seen later on. Another advantage of a high watershed is that evaporation is at a minimum, and the loss from this cause much less than at lower elevations. It is safe to say, however, that the most important consideration in the character of a watershed, when its ability to produce an underflow is considered, is the nature of its soil formation. The surface must be loose and porous, allowing water to sink readily and penetrate it, while there must be a hard and impervious substratum at a reasonable depth, which is continuous, or practically so, from the summit of the watershed to the channel of the stream. If the surface soil is too hard and compact the rainfall will practically all flow off as surface flow into the channel of the stream, and very little, if any, will find its way into underground channels and produce an underflow.

Even if the surface of the watershed is as soft and porous as may be desired, if the substratum is not hard and continuous, but contains deep crevices and fissures leading to underground layers of softer material, or if the substratum is too deep and conducts the water down to other strata of loose material, the water which sinks will be conducted to considerable depths and distances, and instead of forming an underflow may reappear as springs or artesian water.

A FAVORABLE SURFACE TOPOGRAPHY.

The nature of the topography of the watershed or country contiguous to a stream has a remarkable effect upon the creation of an underflow in the stream. If the watershed pitches steeply downward and is very abrupt to the banks of the stream and its branches or tributaries, the water will flow off and into the channel very quickly without much of it entering the ground. After reaching the channel very little water sinks as a rule, except in

very exceptional cases, the channels of streams being usually covered with a coating of silt, which effectually prevents percolation to any appreciable extent.

On watersheds of diversified topography containing flats, wide canyons and broken and irregular ridges running in different directions, the opportunity for water to sink is good, and a large proportion of the water falling will enter the ground and become a part of the underflow, if the substratum below will sustain it down to and along under the channel of the stream.

Considerable importance attaches to the question of topography, and in studying a watershed respecting its ability to produce an underflow, an examination, as detailed as possible, should be made to ascertain the opportunities afforded for water to sink or run off.

SUFFICIENT AND PROPERLY DISTRIBUTED PRECIPITATION.

The fall of rain or snow on a basin or watershed must be sufficient and properly distributed throughout the year in order to create a good underflow from the drainage. If the showers are too sudden and violent, and partake more of the nature of a cloudburst of great discharge but short duration, the water will have but little opportunity for sinking into the ground. Too light rains are also undesirable as they either merely saturate the ground or the water is evaporated or transpired by the growing vegetation.

If the rains occur at intervals too far apart, the result is also unfavorable to underflows, as the supply will be likely to become low or fail at times. The best rainfall for producing a large and unvarying underflow in a stream is that which occurs in moderate showers and without the intervention of too long intervals. If the year is divided into a wet and a dry season, the lack of moisture in the form of precipitation during the dry season may be compensated for by snow which has fallen during the wet season and gradually melts during the dry season, thus keeping up the supply.

Snow is the best form of moisture for keeping up a constant and unfailing supply of underflow under all circumstances. The melting of snow requires time and gives ample opportunity for the water to sink and reach the underflow.

PROPER CHARACTER OF CHANNEL AND SURFACE FORMATION.

In order to contain an underflow the channel of a stream must have a stratum of loose material through which the water can percolate after reaching the lowest dip in the bed rock or other impervious formation. If the bed of a stream is directly on the impervious formation extending throughout the watershed or basin, no underflow is possible, as the water sinking where this formation is covered by loose material, will again rise and become a part of the surface flow upon reaching the bed of the stream. It is not necessary, however, that the loose stratum should be continuous from the surface of the channel down to the bed rock or underlying impervious stratum. The underflow is often separated from the surface flow by one or more impervious strata; in fact, such a condition is more frequently met with than one where the loose formation is continuous.

Such impervious strata are deposited by the water and may consist of conglomerated or cemented gravel, compact clay, hardpan or other solid matter deposited by the water and firmly united by means of some component part causing adhesion. The only condition required where such strata exist is that they do not touch the impervious formation underlying the whole watershed, but are separated from it by some loose stratum, through which the underflow can move unimpeded. Cases where the two touch are very rare, owing to the fact that in all large drainage basins heavy floods have made deep loose deposits before the subsequent layers of the impervious material were deposited. In cases where the loose stratum is continuous and not interrupted by intervening impervious strata the whole stream may sink and become underflow, unless the water carries silt sufficient to line the channel, or the flow of the stream has a sufficiently large volume and velocity to pass on even after filling all the voids in the material comprising its pervious bed. The surface formation of the watershed tributary to the stream must be loose and porous and be underlaid with an impervious stratum practically continuous to the channel of the stream in order to create any considerable amount of underflow.

A hard barren watershed, which does not

afford facilities for the water to sink, but which causes it either to flow off or be evaporated, is not capable of producing any considerable underflow, even when all other conditions favorable to an underflow are present.

A HARD SUBSTRATUM.

As has already been intimated, the existence of an impervious substratum is an essential to the production of an underflow. This applies both to the channel and watershed of the stream. The want of such a substratum, at an attainable depth below the surface, causes the water to sink downward as subsoil water. On the other hand

an impervious substratum at a reasonable depth, having an inclination somewhat the same as the surface, will intercept the water sinking through the loose surface formation. The downward pressure of the water, together with the impenetrability and inclination of the substratum, will cause the water to percolate in the same direction as the trend of the watershed and channel of the stream. As long as the substratum continues impervious, inclined and sufficiently near the surface, an underflow, the extent of which depends on the other conditions already discussed, will be found to exist.

(To be Continued.)

EXTRA FINE FURROW IRRIGATION.

But just as cheap and easy as any. Land graded to uniform slope, streams all regular in size and flow. Utilizing ground between orange trees.

THE ART OF IRRIGATION.*

CHAPTER X. IRRIGATION BY FURROWS.

By T. S. VAN DYKE.

IN orchard work many of the best irrigators run but two furrows to a tree, one on each side, the first year, two on each side the second year, and so on until the third or fourth year when the whole intervening space is filled. Others gridiron the whole ground at once and lead the roots of the

trees away from the trunk and out into the warm, sunlit soil as rapidly as possible. This is the better way where one has the water and time. And where one wants to make the place pay its way from the start one can raise a large amount of produce in the space between the young trees without any perceptible injury to them. This is now a common practice in many places

*Copyright 1886, by T. S. Van Dyke.

though some condemn it. Theoretically it injures the trees by drawing too heavily on the soil. Practically it does nothing of the kind and the difference cannot be seen. Of course the extra product is an extra drain upon the fertility of the soil, and will hasten the time when fertilizers must be used. But most all ground is rich enough for young trees, while no ground is rich enough for old ones in full bearing. The time will come when you must fertilize anyhow for large yields of high-grade fruit, and in the meantime by using the ground you have some returns before your orchard comes into bearing. If the ground is well irrigated and cultivated the amount of stuff that can be raised between the rows under a warm sun without apparently injuring the trees is wonderful, and helps out many a poor man in California. But it must of course be done with care and good judgment.

REGULATING THE FLOW.

When everything is ready and the water turned into the distributing flume there is little to do but regulate the gates. This is not much of a task, even the first time, for they may be set very nearly by guess. But you should go along the line to and fro several times watching the flow closely so as to get it as even as possible from every hole. It is not easy to judge of the amount of flow by the size of the stream, for velocity is as important a factor as thickness. But by watching the discharge a while, and the way the water flows down the furrows you will soon have the gates set so as to insure quite an even delivery to each furrow. Give the small boy of the ranch a half dollar to let them alone and you will have little or no work with them the next time.

With hoe in hand go over the field a few times and see that the furrows are all right. Some think bare feet and legs essential to thorough irrigation. So they are for shiftless people and for flooding they sometimes are in the best work. But for small furrows, after you have everything working right, you will need nothing but slippers and will hardly soil them.

You need not spend any time coaxing water down a furrow. This will do in a little garden patch, but on a tract of any size it is an endless job. If the water does not run fast enough after a fair trial open the gates a little more. But be

careful how you decide it is not running fast enough. Patience is here the cardinal virtue. The water may seem to drop out of sight too soon and yet be creeping along below and filling up toward the top. Give it at least twenty-four hours to go 660 feet. If your soil has stood the test before mentioned the water will probably get through, though very slow at the start. Once acquainted with the vagaries of your soil you will have little trouble. You will know whether to crowd on more water at the beginning and force it through or to wait and let the smallest streams work their way. When you can have the irrigating head long enough the latter course is most always the best. If limited to a short run you will, of course, have to force it through with larger streams. The length of the run will be considered further on.

THE WASTE WATER.

To insure good wetting of the lower end of the tract some waste must run off. If the tract is well laid out this should not exceed five per cent and on many places it is almost nothing. But even a little may be considerable in amount and it is well to provide some way to utilize it. Considerable firewood, as well as shade, and wind-break for things like oranges that do best in almost dead air, is grown in this way in some of the dry sections. Where the waste amounts to anything and is run in a ditch along the outer edge of trees it will generally keep the roots at home instead of allowing them to rob the main tract as they are apt to do if left to shift for themselves. In the dry countries no unnecessary trees or large shrubs should be grown around the irrigated tracts, unless in some way supplied with water to keep the roots at home. In a garden the waste may be used for berries, a small alfalfa patch for the cow or chickens and many other things. As it carries considerable of the fertilizers that may be used, it should never be allowed to run away as it generally is. At the same time provision for waste ditches should be made as water is at any time liable to escape under careless management and do damage.

SMALL STREAMS BEST.

One who has never watched them for a whole season can scarcely believe the work done by streams so small that they never

run muddy, never out and never build bars. But if the soil is close enough to permit it, they are as much superior to all other modes of applying water as a long slow rain is to a cloudburst. In its present perfection the system was first worked out at Riverside, California, by people with the means, the time and the inclination to experiment. It has worked its way around wherever it is possible to apply it, and its value over all else on fine soil can be no longer questioned. The only exception is that before given, of alfalfa and some other crops on a very large scale, where it is simply a question of economy in handling the water and not one of results.

"Yes?" I replied. "We carry twice that load on trees in California and pull them through with ninety per cent of first grade fruit on."

He wheeled around on the seat and stared at me from head to foot until the horses almost ran into the ditch.

"That's correct," drily remarked the editor of *The Redlands Citrograph*, one of the oldest and most practical fruit growers of Southern California, who sat beside me.

"They are suffering for water. They look leathery," I continued.

He wheeled around with another look that said as plainly as words:

A SPECIMEN OF VERY POOR FURROW IRRIGATION.

Amount of water about five times too great; uneven feed of water into different furrows. Such work washes off the fertilizers, leaches the natural fertility out of it and is in every way bad, because wholly unnecessary.

How far people may drift from this easy and effective work and lose money without knowing it, is well illustrated by the following:

At Phoenix, Arizona, in June last, I was shown an apricot orchard by the owner, who was driving. As we came up to it I could see fifty yards away that the fruit was runty and tough. The soil, climate, and all natural conditions were apparently the very best for the highest perfection of the apricot.

"Those trees are too heavily loaded and I haven't had time to shake any off," remarked the owner.

"Why, what asylum have you just broken loose from?"

Then he added with a sneer.

"They have had lots of water."

"They are suffering for water all the same," remarked the editor. "There is no mistaking the leathery look." Then he got withered with a look of terrible contempt.

"That furrow on each side the trees had about fifteen inches of water fired down it; didn't it?" I asked. It showed plainly what the answer would be.

"About that," he replied.

"And it ran muddy at once, and in this

fine soil coated the bottom and sides of the furrow with a fine slime?"

"Y—yes," he answered. He need not have taken the trouble, for the dried slime spoke for itself.

"And when it dried, instead of cultivating and breaking it up you left it to crack."

He did not answer this. The furrow answered for him.

"And when it dried and cracked until it got dry enough you fired more muddy water down it and puddled the cracks. And you let it dry and form new cracks and then puddled them again. And you repeated this process several times a year for two or three years until it now comes near being a cement ditch. Consequently a tree may stand within three feet of it and get moisture enough to carry half a crop fairly well but not get enough evenly distributed through the soil to feed up to the point necessary to carry a big load up to first grade."

"That's what's the matter," remarked the editor.

The owner did not say much, but the chances are he is still running that field in the same way without a particle of cultivation, keeping the same old furrows and puddling the new cracks in them as fast as they form. The number of people who can comprehend the folly of working out anew for themselves things that for years have been worked out for them somewhere else is very small.

By a long run of a small stream instead of a short run of a big one, and with good cultivation of the whole, breaking up the furrows each time, these trees would have done as well as any trees in California. The soil was fine enough to permit it, and it would have taken far less water to produce twice the crop and make it nearly all first grade.

EXPERIMENTS IN CALIFORNIA.

On a place where I once spent three years, and took considerable interest in the irrigation because I was depending on it for fruit, the watering was all of this kind. It was in 1879, and little was then known about irrigation in California, the methods being of the crudest types. But it would not have paid to use anything better in this case, for there was no market for the fruit and it was raised only for home use.

A little dam across the creek furnished a head of about twelve inches for six hours every three days and there was nothing to do but go up and pull out the shingle that formed the gate. I soon found that the trees had grown balls of thread roots close up to the ditches and that the water soaked but a short distance to the sides. The fruit was very good provided there was not much of it. When there was it was small, sour and flat. This was in a region where the rainfall was about twenty inches, and trees would live and bear something without any irrigation. But it was then plain to me from some experiments I made that, while the trees got drink enough through the skeins of thread roots they had formed along the ditches, there was not enough ground sufficiently wet to enable them to feed the tree properly when well loaded.

Many such little ditches are still found in out-of-the-way places, and they bear well enough for home use but not enough for heavy profit. And the results look very fine to one who has never known what it is to market a crop of fruit. When one learns that nearly all the profit is in the first grade, and that the second hardly pays expenses, while the third had better go to the hogs than ruin the reputation of the grower and his locality by going on the market, one begins to find out where he is. And if the place has a mortgage on it he may be behind on the interest, while some one, with conditions not as good, is making large profit out of every acre.

In 1878 I experimented with these small streams on adobe soil of the blackest and stickiest kind. I wanted vegetables and could get them only by raising them myself. I was limited to a windmill from a very deep well, making the stream small and slow. But I was surprised to find that a very small stream soaked sideways with great rapidity, and that nothing was gained by increasing it so long as it flowed at all. All it wanted was time and this it had to have no matter how long.

On some soils, however, this will be an absolute failure. In 1877 I tried the same thing on some alluvial soil of very fine appearance and very rich. But the water fell through it as fast as it was turned in, and if the stream was increased enough to force its way along then it puddled the sides and bottom and still re-

fused to soak far enough to the sides to be of any use for anything unless planted almost on the ditch. A tree could have stood within two feet of it and got no water until it sent roots to it and then would get only drink, the ground remaining too dry to enable it to feed. Quick flooding is about the only way to handle such ground.

A NEW JERSEY INSTANCE.

My first experiment with irrigation was in New Jersey, in 1856, at the age of fourteen. There was a very dry spell and we had in the garden a new variety of sweet corn, to which I was very much attached and I tried to save it. The gardener and my father both told me it was no use to try to water it, but I went at it with a pail and packed water from the well for nearly half a day and poured it down the rows. Then the hired man started in to help me and we gave it what seemed a good wetting. The result was a practical failure, though there was more corn than there would have been had we not watered it. Looking at the same ground years after it was easy to see what was the matter. It was a loose red shale soil lying upon fissured rock. This rock was thoroughly dry, for we did not begin to water until all hope of rain, enough to save the corn, was past. The water dropped through the loose texture of the soil and the fissures of the bed rock drank it up as fast as we could pour it in. The quantity

that seemed so great to us because pumped from a deep well and packed some fifty yards by hand was really but a trifle compared with the needs of the soil. Assuming that we carried five gallons a trip with two pails from the pump to the patch, and made thirty trips an hour for five hours, which is more than we did, we put on 750 gallons. This is a trifle more than one-eighteenth of an inch for twenty-four hours, or one-ninth for twelve hours, or one-fourth for about five hours. It was not possible for the water to soak sideways and upward until the crevices in the rock had been either filled or the bottom of the furrows puddled so as to stop the downward flow. The short dashing doses that we inflicted upon the suffering patch had no such effect. The ground either needed flooding or a long run of streams of a third to half an inch and perhaps more. While we made lots of fuss, mud, and slush, the roots of the corn, which were not trained near the center of the furrows, but went straight down, got little of the moisture. Add the fact that the corn was twisted all night after it was in tassel, while the water from the deep well was very cold, and it is easy to see the cause of failure. Many would conclude from this that irrigation in New Jersey was a failure. On the contrary, few States need it more or would show much better results where warm muddy water from the streams could be economically brought upon the soil. I saw this tried in 1898 in a garden at Mont Clair, and showed a friend's gardener how to run small streams. The season ruined all the neighboring gardens, but this one was loaded with produce, of a better quality and earlier than they had ever before seen. The bearing season for beans, melons, and some other things, was extended fully two weeks by it.

(To be Continued.)

NOTE TO CHAPTER X.

[There is no objection to any paper copying any part of this that will be of use to its locality, provided due credit is given THE IRRIGATION AGE and not more than two chapters published consecutively so as to interfere with the sale of the work in book form.

If any one doubts the efficacy of printed precepts in a practical matter like this, let him write to any of the old settlers of Chula Vista, in San Diego County, California, and ask what was the effect of a lecture given the settlers by the author, at the schoolhouse there in June, 1889. Ask if they did not at once reverse their entire methods of irrigation and if they do not attribute to that change the great success they have achieved.]

PRACTICAL IRRIGATION IN KANSAS.

BY C. D. PERRY.

AN adequate supply of water being the first requisite for successful irrigation, I will first mention the four sources of supply in Western Kansas in the order of their relative value as I consider it after eight years of close study of the question.

First, and by far the greatest source is from wells sunk into the sheet water, storing this water in reservoirs, using wind or mechanical power according to the quantity needed. The amount of water that can be obtained in this manner exceeds many times the supply from all other sources combined, and it will be especially valuable because it will always be under the control of the owner of the plant.

Second, the surface flow of rivers, conveyed through canals and ditches, is perhaps the next largest source of supply but is closely followed by the *third* source, the underflow of rivers and streams. I should not be surprised if this source would even exceed in quantity the surface supply of rivers.

Fourth, the storage of storm waters by damming ravines and draws. This last source, owing to the unreliable rainfall of our section, is not of very great importance.

Only small strips of land along the streams can ever be irrigated by their waters, but the bulk of our best lands, the second bottoms and uplands, will forever depend upon wells, and the value of the lands will be in proportion to the depths of the wells.

1887 was a dry year, as many of my farmer friends remember. This was the third year that I, a city chap, had been on that ranch of ten thousand acres and those three years comprised the total experience of my life in farming. In that time I had seen the seed of three crops planted in soil that I prided myself was as good as any. Of those three seedings not one matured a crop. Beginning with that year, the discouraged farmers about me left the country, one by one.

That was the summer of the fateful July winds that parched the magnificent corn crop, everywhere approaching matur-

ity from Englewood to Topeka. That summer, also, the Santa Fe, the road which has been such a factor in the upbuilding of the State, and which as a corporation has had its boom and its collapse unequaled by that of any other institution within our limits, was engaged in running a preliminary survey southwest from Englewood.

This work brought to light the fact that the bed of the Cimarron river, six miles south, was thirty-two feet above the level of the ranch. Realizing the futility of dry farming, we determined about the middle of July to build a gravity canal of sufficient capacity to irrigate their farming lands.

By October such a canal was completed. It was ten feet wide on top, five feet wide on the bottom, and eighteen inches deep, with a fall of two feet to the mile. It was eight and a half miles long, three and a half miles square away from the river to the south line of the ranch and five miles around the western and northern rim of that beautiful valley comprising three thousand acres of irrigable land in the eastern half of the ranch.

At first it was attempted to take water out of the river without a dam. The wide channel and shifting sands rendered that impracticable. A stone dam was therefore built but was soon washed out. After two and one half years of struggle and disappointment it was decided to put in a sheet piling dam 422 feet long; 2 x 8 x 12's were driven down, leaving eight inches above the bed of the river. Timbers were bolted on each side and 600 loads of rock thrown in on the lower side of the dam and finally an apron eight feet wide was bolted on to lower part of 160 feet of dam where the main channel was.

The first time the water was turned in, a stream, one foot deep and sixteen feet wide, was fourteen days going through the eight and a half miles dry ditch. Now it takes but seven or eight hours.

Faulty engineering had to be contended with in laying out the canal, the natural contour of the land not being followed closely enough.

Where the draws and the ravines came down from the hills only one bank was built, thus forming ponds on which the winds made waves that cut out the banks. This was remedied by making the bank strong enough to be split and on which the water could be carried with a drain under the ditch to lead off the rainfall. In other places the ditch was rebuilt around the pond next to the hill. Some of the hills had to be made heavier and after two or three years the banks settled and were grassed over.

I have thus briefly outlined for you our troubles in building the dam and canal, but even after the waters had been brought to the land, our troubles were not ended.

DISTRIBUTING THE WATER.

The main laterals and distributing ditches had then to be built so that the land could be evenly watered. The literature of irrigation was very limited seven years ago.

THE IRRIGATION AGE was not published and the Kansas Farmer did not then devote from a column to a page to the subject. Our State Board of Agriculture did not then set apart a day or a part of a day to the discussion of this question. We had only the scanty government reports and Stewart's Manual on Irrigation to aid us.

To say that mistakes were made is to give you but a faint idea of our discouragements. We often thought it ought rather to be called an "irritation" ditch.

A look over our alfalfa fields will show the traces of four abandoned systems by which we attempted to distribute the water, before the present system was adopted.

Before describing it, let me say, I can conceive of no way of having absolute control of the water at all times except by the basin system, which requires very level land and a great deal of very hard work.

According to our system, the distributing laterals, either for running the water down the corn or orchard rows or for spreading it over on alfalfa or grain field, are all laid out to a uniform grade of one inch to 125 feet of length of lateral. This grade has been adopted as the result of experience.

We have found that six-inch banks and a canvas dam to raise the water that much above the natural surface, allows us to take the water out along the desired length of

ditch of about 400 feet with a margin of safety. With a fall of only one inch to 125 feet it is necessary to raise the water only three inches at the dam to back it up so that it can be taken out for 375 feet.

This margin of safety in a six-inch bank, allows us to make holes in it about sixteen feet apart and to divide the water in the lateral so that it will be evenly spread down over the land between this lateral and the one next lower down in the field.

By laying out the laterals on this regular grade, the lands or sections of the field to be irrigated are made irregular in width because the slope of the land is irregular. In order to determine how far apart these distributing laterals shall be, you must find out how far you can run the water economically over the land. In the case of hoed crops and of orchards, this distance will probably be greater than in the case of those crops that are flooded.

Most of you have observed how short a distance the stream of water pumped by an ordinary windmill will run down a furrow before it is all absorbed by the earth.

No matter how long you pump, the water never flows any farther. The distance the water will run is determined by three factors: First, the texture of the soil; second, the slope of the land, and third, the head of water at your disposal. However, I am not giving you a general rule for your guidance. The conditions are different on each farm, frequently on different fields of the same farm, more especially on bottom and second bottom farms, where the soil is mostly "made land."

I am only giving the sizes of laterals and of irrigating "lands" as we have them on Claremont ranch. Our distributing laterals are from three to five feet wide, rounding on the bottom and carrying water from six to ten inches deep. We aim to make our irrigating "lands" at the start about 250 feet wide. But in running the laterals a quarter to a half a mile, the "lands" might be made to vary from 150 to 400 feet, according to the slope in the field.

These distributing laterals are laid out with a surveyor's level on a tripod. One person managing the level and another carrying the rod and finding therewith the proper points of the proposed line

every 120 feet on comparatively level land. But if the land is irregular the points should be taken at about half that distance apart.

The man carrying the rod marks these points with mounds of dirt, thrown up with a shovel, which serve to guide the one who plows out the laterals.

These laterals at the given fall vary but little from the level contour lines of the land and so run at almost right angles to the greatest slope. Therefore, when the water is turned out of the lateral it runs away from the lateral at almost a right angle to the next lateral below and at a speed varying with the slope of the land, the texture of the soil and the head of water.

These questions of size of laterals and of irrigating "lands," each man will have to settle for himself. This he can readily do in a small way before laying off his field. But if that part of the land being irrigated just below the lateral being used absorbs from fifteen to twenty inches of water, while the lower side is getting four inches (the amount necessary for one watering), there must be a great waste of water, and damage may be done to that part of the crop receiving too great an amount.

If this is the case, the distributing laterals are too far apart. Having these contour distributing laterals built, you can now ordinarily locate the supply lateral from the canal or reservoir, as the case may be, along the sides of your field crossing the starting points of your distributing laterals.

We use a portable canvas dam to divert the water from the supply lateral into the distributing lateral. The same kind of a dam is used to check the water in the distributing laterals.

Constructed on this plan one man on our ranch is enabled to spread the water and irrigate 1,000 acres once, and 800 acres of this two and three times.

To wet the land evenly from ditch to ditch it must be graded down the slope, so that the water will not run around hillocks or too much remain in hollows. This grading we do with a common slip scraper, or, preferably, with a Stuart land grader. We have a home-made leveler which we use in the place of a harrow which levels the minor inequalities, and a home-made A-shaped tool for cleaning out

the ditches and laterals. As a hill torn down or hollow filled up is a permanent improvement and lessens the amount of water used and increases the crop, it always pays to do this work.

Beginners generally use too much water. The best crops that we have raised had but one watering and that in the fall. A thorough wetting of the subsoil, according to our experience, is what is necessary.

Corn will never, in my opinion, be a profitable Western Kansas product, but in Kaffir corn we have a crop for us equally valuable. For seven years past a wail has gone up from Western Kansas. As the hot winds blasted the crops, the people blasted the country.

The one hundredth meridian line crosses our land, that mysterious line from beyond which all settlers are warned, and few indeed are they that have returned from there with pocket-book intact. But looking back over these same seven years I can truly say that irrigation has given us crops, good, better, best, according to how well our farming and watering has been done. I have many times thought that if I could irrigate the prices up as readily as I can irrigate the crops up, great would irrigation be indeed!

You have been told, year in and year out, of the beauties of irrigation, and as you have listened to the glib oratory, it has seemed to you an easy thing to irrigate land, but I have tried to tell you that it takes good hard work, it takes patience and it takes skill and brain work to get your water supply and then to use it so that the best results and profits will follow.

CANAL AND LATERAL ON THE CLAREMONT RANCH IN KANSAS.

HISTORY OF IRRIGATION IN NEBRASKA.

BY I. A. FORT.

THE following is a brief history of the inception and commencement of the construction of irrigation canals in that part of America lying east of the Rocky mountains.

During the past three years of active discussion of the irrigation questions, we have read and heard of the merits of different canal systems of the United States, yet the pioneer irrigation country of the great plains of America has remained silent.

Lincoln County, Nebraska, claims precedence in the leadership of the irrigation movement of the great plains. As far as can be learned from careful inquiry the first irrigation canal constructed by Americans on the territory designated was built by a gentleman now residing in North Platte, Nebraska, by the name of Washington M. Hinman. Mr. Hinman first commenced excavating a small canal in the month of March, 1863, taking his water out from the south bank of the South Platte river, at a point about six miles west of old Fort McPherson, now in Lincoln County, Nebraska. In the spring of 1864, another resident of that vicinity, John Burke, of Cottonwood Spring, near the same military post, commenced the construction of another canal a little below Mr. Hinman. Both of these canals were used. Mr. Hinman's in both the summer of 1863 and 1864, and Mr. Burke's during 1864 and 1865, and a large amount of valuable farm and garden produce was gathered and sold to the soldiers and residents of the post, but the Indian war, breaking out in 1864, made farm labor and irrigation both difficult and dangerous and no crops were planted on the lands subject to irrigation by these ditches after 1865, and the canals were abandoned.

A CORPORATION ORGANIZED.

In 1870 there was a stock company formed in North Platte, Nebraska, and a small canal was excavated that obtained its water from the South Platte river, at a point about four miles west from North Platte, the head gates being located on

the north bank of this river. This canal was capable of irrigating about three thousand acres, situated in and about the town of North Platte. Only three crops were grown on the lands thus watered by this ditch. As the rapid growth and development of the free range and stock interest during these earlier years entirely eliminated all interest in everything pertaining to agriculture by the cultivation of the soil in this vicinity the canal was abandoned. But North Platte still retains some of the benefits derived from this work, in the growth and development of several long rows of magnificent trees now standing that were planted in those years along the line of this canal. In 1871 the soldiers of Fort Sidney, Nebraska, constructed a small canal that was used to water the trees and also the post gardens. This has since been abandoned also, owing to the non-occupancy of the fort by the United States troops.

In 1883 a promoter, by the name of E. M. Day, of North Platte, organized a canal company at this point, that after several changes in its organization finally completed a canal, now known as the North Platte Canal, that was twenty miles in length and was capable of irrigating twenty thousand acres of land. This canal is one of the permanent works of this section and has been the means of educating the people of Nebraska to the great benefits and value of irrigation. In 1887 the people of Scotts Bluff county, Nebraska, commenced the construction of irrigation canals, and in 1890 the Culbertson canal of Hitchcock county was proposed and commenced. Since this date the irrigation sentiment has been steadily increasing, and at the present time, with the canals now completed and under construction that will be finished before 1897, Nebraska can claim to have over a million acres that are susceptible of irrigation, by means of the canals, that will insure a permanency to her agricultural population and guarantee bountiful crops in all years to come.

ALKALI.

DEFINITION AND METHODS OF TREATING IT.

BY E. M. SKEATS, OF NEW MEXICO.

WHAT is alkali? Webster's dictionary says "a salifiable base, having in a greater or less degree a peculiar acrid taste, the power of changing blue vegetable colors to green and the color of turmeric and rhubarb to brown. Potash, soda and ammonia are the leading alkalies." That is more or less the answer a chemist would give to the question, but since irrigation has become a popular science the definition requires enlarging. To an irrigationist alkali has come to mean any efflorescence which may form on the surface of the ground. The irrigationist divides this alkali into two classes, one he calls "black alkali" which is very harmful to vegetation, the other he styles "white alkali" and he considers it moderately harmless.

The "black alkali" consists in great part of the carbonates of potash or soda; these have great solvent power on vegetable matter, turning it black and killing live plants in contact with it. It is decidedly dangerous and is a true alkali.

But with regard to "white alkali" the name is misleading as very frequently the white efflorescence contains no alkali at all, according to Webster's definition, but may consist of any salt which is soluble in water; it may be a valuable plant food, or it may be a poison, or it may have no effect at all on plant growth. It consists almost always of the mineral matters in solution in the bottom water. According to the nature of this water (the shallow well water of the neighborhood) so does the nature of the "alkali" vary.

I believe it is a popular idea that "alkali" comes from the soil. Indirectly of course, it does; but not necessarily or generally from the local soil but from soil through which the bottom water has flowed. In very few cases will you have any alkali at all on the surface unless you have a bottom water within eight feet, and the alkali will consist simply of the solids of this water.

Soil is porous and like a wick and, according to whether it is fine or coarse, it will draw up water to a greater or less height. A very sandy soil will draw it up

about one and a half to two feet, while an adobe will draw it up four or five feet.

Suppose you have, then, an adobe soil and your well shows water within four feet of the surface, and the water contains a large proportion (not necessarily a large amount) of carbonate of soda, you will have "black alkali" in your ground and will have to be very careful how you treat it. This is the case in a few parts of California, in parts of India, and in many parts of South America.

Now, suppose that below you is a district of gypsum beds and that your bottom water flows through these. It dissolves some of the gypsum or sulphate of lime, the sulphate of lime and carbonate of soda in the water change and form carbonate of lime and sulphate of soda. Your friend who, perhaps, has property below these gypsum beds, does not find the same difficulty with his garden that you do. His well perhaps shows the water but two feet from the surface, but the efflorescence on his ground consists of carbonate of lime and sulphate of soda, both of which salts are harmless.

Take another example: Your land is in the Pecos valley—a gypsum formation—your well shows the water seven feet from the surface. The water contains sulphate of lime and magnesia and some common salt.

Through the dry season you have no alkali or efflorescence on the surface, as the soil cannot draw the water seven feet. But a rain comes, or you irrigate, and the soil is wetted down to where it can draw the bottom water. The water from above mixes with that from below and dissolves much of the lime, magnesia and salt which the latter has left two or three feet below the surface. This is now drawn farther up and appears on the surface after the sun has dried it. It is thus that an efflorescence can appear when the bottom water is as much as eight feet from the surface, though the soil can only draw it a little more than four feet.

In this instance the efflorescence consists of sulphate of lime and magnesia and common salt with no true alkali, and

except when it is allowed to become very strong it is harmless; it even acts as a fertilizer.

Again suppose your land is in Egypt, your well showing the water three feet from the surface of a sandy soil. After a rain or irrigation an efflorescence will appear. The water in the well contains but small quantities of carbonate of lime, carbonate and sulphate of magnesia, sulphate of potash, chloride of soda, and traces of phosphoric acid and ammonia. The efflorescence will consist of the same and act as a very fine fertilizer.

In general the nature of the alkali will be governed by the geological strata of the district. Where there are granite hills and valleys with rich clay soil, the black alkali may be feared, but the soil will be extremely productive. Parts of California and India exemplify this.

In a limestone region the alkali will be probably carbonate of lime and there is likely to be some common salt and magnesia. It will be harmless, but the soil will not be as rich as the last. The district east of El Paso may be taken as an example. It is in the cretaceous with granitic formation underlying. Where the strata is broken here the soil may be more like the last.

In the Mesilla valley and the Pecos valley we have districts in the cretaceous underlaid by the gypsum. Where there is efflorescence it consists of carbonate of lime, sulphate of lime, sulphate of magnesia and common salt. The abundance of sulphate of lime precludes the possibility of the presence of "black alkali."

I trust that I have made it clear that we need a revised Webster for irrigation districts.

IRRIGATION IN SOUTH DAKOTA.

BY J. M. GREENE.

THE irregularity of rainfall, or the entire absence of it at times, created the necessity of irrigation. Water applied at the proper time insures success, and the uncertainty of the supply coming through natural channels has made it necessary to procure it by artificial means. It is not the purpose of this article to go into the many advantages possessed by irrigation wherever practiced, but to deal with it in one section only.

The writer has looked over the irrigation districts of Colorado and California, and in these States the development of irrigation in the past ten years proves conclusively that it is a profitable and permanent industry. South Dakota has just awoke to the fact that there is no area of corresponding magnitude in the world that can be so cheaply irrigated as what is known as the artesian basin, which underlies a large portion of the state; cheap for the reason that every quarter section of land in the artesian basin can be supplied with more water than is needed for irrigation or any other purpose, by drilling an artesian well varying in depth, according to locality, from five hundred to one thousand feet and giving an unsupported flow of

water above the surface of the ground from six inches to sixteen feet high. Two years ago irrigation was almost unknown in Brule County, South Dakota. One year ago some experiments were made by drilling wells for irrigation and the results were so satisfactory, both from the standpoint of profits and cheapness of development, that during the coming season 7,000 acres will be irrigated. The beauty of the artesian well system of irrigation is that every farmer can own his own well and water, and be independent of any and all water companies. He can use the water when and where he chooses. He can construct a reservoir on the highest ground on his farm and turn his well into it there. Reservoirs can be cheaply constructed by the farmer himself. If he has, for instance, a six-inch well and desires to irrigate 1,000 acres he should have a reservoir that would hold five or six acres of water. To construct such a reservoir it should be laid out in a circle; take all the sod off where the bank is to be made, plow up the center of the circle, and haul the loose dirt into the bank with common scrapers, giving the bank from one-fourth to one-sixth pitch, building the banks

from six to eight feet high. An excellent and cheap remedy to prevent the waves from washing the banks is to rip-rap them on the inside with willows, tying the willows to the bank with No. 12 galvanized wire attached to stakes and driven into the bank. If care is taken in selecting live willows and at the proper time of year, a sufficient number of them will grow to hold the bank of your reservoir from ever washing. There are a number of other ways to save the banks from being destroyed by waves, but I consider that where the willow can be had cheap enough they are the best.

The writer is not a theorist as he is developing a 640-acre irrigated farm in Ola Township, Brule County, South Da-

large stream of water, the reservoir system increases its value and efficiency by furnishing all the water needed to irrigate and at the proper time, when the water affords the most benefit to the soil. It also has the advantage of being a great saving of time. The water that can be let out at one time from the reservoir that I have just constructed and described will cover 320 acres of land one inch deep. From my experience so far, and the way my land lays and ditches are constructed, it will take two men four days to distribute the water over this amount of ground, while some of my neighbors who have stronger wells than mine, but no reservoirs, cannot do the same amount of work in five times as long.

SECTION OF RESERVOIR ON IRRIGATED FARM OF J. M. GREENE IN SOUTH DAKOTA.

kota. The reservoir has been constructed on the plan stated, covering seven acres of ground; the banks are eight feet high on the outside, giving about that depth for water on the inside; the gates or outlets are protected with galvanized screen wire, as it is intended to stock it with fish in the spring. The reservoir has been full of water for the past two months, during which time a number of heavy windstorms have occurred without damage to the banks, which proves the willow rip-rap a success. The well that supplies the reservoir is 1,030 feet deep, and flows 800 gallons of water per minute, and although this of itself makes quite a

There need be but very little expense to a farmer in constructing his reservoir and ditches in South Dakota. He can do this work in the winter time when he has very little else to do, by plowing the ground thoroughly before the hard frosts of winter occur. A great many miles of ditches were constructed in this county during the months of January and February, also four or five reservoirs, which goes to show that the industrious farmer can do this work all himself during the winter time, and the only expense or actual money needed in developing an irrigated farm in the artesian belt of South Dakota is for drilling his artesian well.

IRRIGATION LEGISLATION.

RIGHT OF WAY FOR CANALS AND RESERVOIRS OVER GOVERNMENT LANDS.

BY L. H. TAYLOR, OF NEVADA.

SECTIONS 18, 19, 20 and 21 of the act of Congress approved March 3, 1891, entitled "An Act to repeal timber-culture laws, and for other purposes," grant the right of way through the public lands and reservations of the United States for the use of canals, ditches and reservoirs heretofore or hereafter constructed, upon the filing and approval of the certificates and maps therein provided for, but the applicant for such right of way acquires no rights until said maps, etc., are approved by the Secretary of the Interior, and such right attaches from the date of approval. In this the law is defective, for in the interim between the filing of the application and its approval the land is subject to entry, and being entered by anyone unfriendly to the project the applicant has no recourse but to buy out the entryman, or to condemn the right of way under the law of eminent domain, and if the applicant be a private individual and not a corporation he has not this latter resource. So the act above referred to should be amended so as to provide that after approval of any application thereunder, the right of way granted shall refer back to and attach from the date of filing said application—or better yet, from the date of beginning of the necessary surveys, the same as a homestead filing refers back to the date of settlement.

Another amendment which appears necessary to this act is one providing for its extension to unsurveyed as well as surveyed lands. It may be argued that on unsurveyed lands there is no means of properly describing the right of way, but this can be done in the same manner as in the case of mineral entries.

It may often happen that all or a part of a reservoir site or canal location is upon unsurveyed land, and this may be occupied by a settler at any time before such canal is constructed or the reservoir filled with water, and thus a great hardship worked upon those engaged in such construction, or the enterprise be stopped altogether.

Unhappily, there are only too many men on the lookout for just such opportunities to blackmail legitimate enterprises, and it should be the function of the law to afford protection against such. So it is to be hoped that this matter may be brought to the attention of, and acted upon by Congress at its present session.

The Court of Appeals of Colorado holds that an appropriator of water of a river cannot enjoin another subsequent appropriator of the water of a tributary below the point of the first party's location, from using the water of the tributary on the ground that such use reduced the quantity of water in the river so that lower appropriators, whose appropriations were prior to that of the complainant, did not receive the amount of water they were entitled to unless the first party supplied the deficiency from his share of the water, where the prior appropriators are not made parties to the action.

Larimer & Weld Reservoir Co. v. Water Supply & Storage Co., 42 Pacific Reporter, 1020.

CONSTRUCTION OF CONTRACT WITH WATER COMPANY.

A contract between certain parties and a water company gave the former the option to buy from the latter land described in the contract, at a certain date, "in accordance with the rules" of the company, at a price stated. The Supreme Court of California held that such parties were not entitled to any water rights, in the event of their election to buy, in the absence of any rules by such company entitling them to such rights. The fact that such company had adopted a system of allowing certain leases to be made with the privilege of purchasing, "the purchase price of the land to be in full payment of, and to entitle the purchaser to, a permanent water right to the use of the water from the company's canal, corresponding to the number of acres bought by him," etc., did

not constitute "rules" of the company, such as would entitle these parties to any water rights with the land.

Giddings v. Land & Water Co., 41 Pacific Reporter, 788.

CONTRACTOR'S LIEN ON IRRIGATION DITCH.

The Supreme Court of New Mexico holds that, where a contract provides that payment shall be made for the work on final estimate and certificate of an engineer approving the work, and a showing that the work is free and clear of all liens, and after the final estimate is made, and the certificate is procured, the contractor being refused, files his lien, the fact that subcontractors subsequently file liens for work will not defeat the contractor's lien.

Ford v. Springer Land Association, 41 Pacific Reporter, 541.

DAMAGES TO RIPARIAN OWNER.

Where the water of a stream running through a farm is taken by a village for its water-works, the owner is entitled, not only to damages from being deprived of the water for farm purposes but, where he has laid out part of the farm in village lots for sale, he is entitled to damages from being deprived of the opportunity to sell water rights to purchasers of the lots.

Bridgeman v. Village of Hardwick (Supreme Court of Vermont), 32 At. Rep., 502.

RIPIARIAN RIGHTS.

The right of a riparian proprietor in or to the waters of a stream flowing through or along his land is not the right of ownership in or to those waters, but is a usufructuary right, a right, among others, to make a reasonable use of a reasonable quantity for irrigation, returning the surplus to the natural channel, that it may flow on in the accustomed mode to lands below. If his needs do not prompt him to make use of them, he still has the right to have them flow onto and along and over his land in their usual way, excepting as the accustomed flow may be changed by the act of God, or as the amount of it may be decreased by the reasonable use of upper owners and riparian proprietors. But none of his rights to put the water to legitimate uses is lost by mere non-user. His rights are not easements, nor appurtenances to his holding. They are not the rights acquired by appropriation or by

prescriptive use. They are attached to the soil, and pass with it, and may be lost only by grant, condemnation, or prescription. With any use or diversion of the water, after it has passed his land, the upper riparian proprietor, having no ownership in, and no longer any rights to it, would have no concern. None of his rights would or could be impaired thereby, and without such an impairment he would be without injury and, consequently, without cause for complaint or redress. His right extends no farther than the boundary of his own estate. He cannot complain of the mere facts of the diversion of the water-course either above or below him, if, within the limits of his property, it is allowed to follow its accustomed channel.

Hargrave v. Cook (Supreme Court of California), 41 Pac. Rep., 18.

The Supreme Court of California holds that a lower riparian proprietor has no right, independent of contract, to go on the land of an upper proprietor to return the stream to its original channel, when it has been diverted therefrom by natural causes.

Wholey v. Caldwell, 41 Pac. Rep., 31.

ORAL PERMISSION A MERE LICENSE.

An oral permission given to divert and use water from a stream is a mere license, which is revocable, and does not vest any estate in the land. There is a clear distinction between the effect of a license to enter lands, uncoupled with an interest, and a grant. A grant passes some estate of greater or less degree, must be in writing, and is irrevocable unless it contains words of revocation; whereas a license is a personal privilege, can be conferred by parole or in writing, conveys no estate or interest, and is revocable at the pleasure of the party making it. There are also other incidents attaching to a license. It is an authority to do a lawful act which, without it, would be unlawful, and while it remains unrevoked is a justification for the acts which it authorizes to be done. It ceases with the death of either party, and cannot be transferred or alienated by the licensee, because it is a personal matter, and is limited to the original parties to it. A sale of the land by the owner instantly works its revocation, and in no sense is it property descendible to heirs.

Jensen v. Hunter (Supreme Court of California), 41 Pac. Rep., 14.

THE DIVERSIFIED FARM

In diversified farming by irrigation lies the salvation of agriculture

KAFFIR CORN.

BY J. W. GREGORY.

Those who have pinned their faith to the idea that the Great Plains country would be made habitable, have felt sure that time and investigation would reveal certain crops adapted to the conditions there prevailing. Already the success of alfalfa growing in the valleys and, under irrigation, on the uplands, has gone a long way towards solving the problem of utilizing for homes these vast stretches of most fertile soil. Hard wheat, too, has demonstrated its profitableness to the persistent sower, and sorghum will be a factor of no small value; but it is doubtful whether any other single crop, thus far tested, approaches Kaffir corn in real value as an all-around, every year reliable standby for the great semi-arid areas of the country.

Kaffir corn, like all the seed-head bearing, drought-resisting grain and fodder crops, is of African origin. Its seed is borne at the top of the stalk like the seed of the sorghums, but in an erect, long and compact head. The leaves are very abundant and long, and hold on well. The grain matures before the fodder and may be cut off before the fodder is harvested—a very decided advantage over Indian corn, which must be cut before the grain is ready for harvesting if the fodder is to be saved. The grain is not only equal as a feed for stock, pound for pound, to the best Indian corn, but has proven so palatable and wholesome for table use that several of the Kansas mills have provided special machinery for grinding it into flour or meal, and it is steadily growing in favor.

The yield of seed was as high as sixty bushels per acre, and will average about the same as Indian corn. In addition to the grain, a heavy growth of the finest fodder is produced, which is greatly relished by stock. Even the stubble, left from cutting in the ordinary manner, will be eaten down to the ground, and the largest stalks are eaten up clean. Horses, cattle and sheep will eat it in preference to the best hay, when tested as to choice.

Few general field crops will better repay thorough tillage and the applica-

tion of plenty of water and, on the other hand, no other crop yet tested will better withstand drought and neglect. If moisture is abundant, Kaffir corn thrives and attends strictly to business. If the water supply gives out and brassy skies and warm winds dry up and blow away Indian corn and crops of similar habits, Kaffir corn simply takes a rest and waits patiently for the next shower.

In general terms, it may be briefly stated that the preparation of the ground, the methods and times of planting and cultivation may be the same as with Indian corn. It is sensitive to frost, but not more so than is its Indian cousin. To make sure of a good full crop, a full average season of continued growth is required. If planting is too late, or cultivation deficient, or moisture lacking, or early fall frosts intervene, there will be more or less of a yield of roughness and more or less grain; but to be sure of a full crop, the seed should be planted as early as Indian corn would be and in ground as carefully prepared, and cultivation and moisture will be as well repaid.

There are two varieties, the red and the white. The red sort has proven greatly superior to the other as a yielder, making itself in about two weeks shorter time, producing a larger average yield of seed, a heavier growth of leaves to the stalk and having a much greater tendency to lift its seed-heads clear off the "boot" or sheath. A large proportion of the heads of the white Kaffir will have a zone of mildewed grains at the base, because of not coming clear of the sheath.

In planting, the seed should not, perhaps, be covered quite so deeply as Indian corn, but the rows should be about the same distance apart and the number of plants to the row or hill should be substantially the same as with the great staple. It may be check-rowed, drilled, listed or sown with results similar to those secured with the Indian corn.

The grain is sometimes harvested with a header and the stalks cut later; but there is danger of the heads heating and spoiling the grain if piled or binned in large masses before becoming thoroughly

dry. The best method of handling is to cut the whole crop close to the ground and after curing in the shock, run heads, stalks and all through a separator having a large proportion of the cylinder and concave teeth removed. This threshes out and separates the grain and puts the roughness in first-class shape for feeding.

If the seed is to be kept pure, the greatest care should be taken to prevent its mixing with sorghum, rice corn, broom corn, etc., which it will do unless kept out at a broad distance.

IRRIGATION IN NEW ENGLAND.

THE Connecticut Pomological Society recently held a well-attended institute at Milford, at the invitation of the Indian River Grange.

"Irrigation in Fruit Culture" was discussed by Mr. J. C. Eddy, of Simsbury, in a practical paper telling of his success in irrigating strawberries the past season. A portion of the field was unirrigated and the results showed a difference of over \$400 dollars per acre in favor of the watered portions. Mr. Eddy said that irrigation can be accomplished on most New England farms by simply directing the many hillside streams that are now running to waste. The successful growth of small fruits demands water at just the right time. Profitable irrigating means supplying an amount of water equal to one inch of rainfall per week. On Mr. Eddy's farm a large hydraulic ram is in use, as the fields are higher than the stream from which the supply is taken.

After the water is raised it is distributed through iron pipes, and at convenient points hose is coupled on and the water thoroughly distributed over the surface of the ground by means of a sprinkling nozzle. Mr Eddy is satisfied with the experiment, which paid its cost the first season.

E. C. Vance, of North Haven, a fruit-grower of long experience, followed with a short paper, giving his methods of getting around a drought by supplying water to berry crops. He makes use of a stream, raising the water with a Rife ram. He is a firm believer in the value of irrigation.

A general discussion of the subject brought out many good points, among

others that the leaf-blight on strawberries is diminished where irrigation is practiced.

Chairman Hale, in telling of the work of irrigation now being done on his fruit farm, said that the near future would see the many streams of water on the farms all harnessed to do the work of irrigation. He cited an instance when a timely shower had made a difference of \$200 per acre in a crop of peaches. But we must not depend on timely showers, but must have the necessary supply of water at hand at all times.

"What is true of the great advantages of an unlimited water supply in fruit growing is also true in respect to grass and other farm crops," said Secretary Gold of the Board of Agriculture.

Mr. Hale said that where the cost of an irrigating plant is a stumbling block, co-operation is the key to the situation.

MICHIGAN EMBRACES IT.

WHEN the subject of irrigation was broached at the recent meeting of the Michigan Horticultural Society, the fact came out that, during the past season, at the Michigan Agricultural College, water was used on small fruits and a variety of garden vegetables. Despite the dry season two waterings carried the strawberries, raspberries, blackberries, currants and gooseberries through their fruiting seasons with little, if any, loss of crop from the dry weather. The gain from the use of water in the case of the vegetables was from three to six fold in bulk, but as the quality was much superior where they were irrigated, the gain in the money value of the crop was even more than this. The water was carried along the ends of the rows in small wooden troughs provided with gates at intervals of three feet along the sides, through which the water could be drawn as desired. Shallow furrows were used to distribute the water along the rows, and as good results were obtained in this way as where tiles, either at the surface or buried a foot or more in the ground, were used. As soon as the water soaked in, the ground was cultivated to keep the moisture from evaporation.

M. E. Williams, of Douglas, Michigan, then told of the results obtained the last

two years in his peach orchard. The water was pumped from a river by means of a steam pump, 400 gallons per minute being distributed. Mr. Williams obtained a marked gain in the growth of his peach trees from the use of water, while the strawberries, corn and potatoes grown between the rows were greatly benefited. He is well pleased with the result.

S. D. Willard, of Geneva, New York, spoke upon the past, present and future of fruit growing, claiming that horticulture had decided advantages over agriculture proper, and that this is likely to remain so for many years to come. He advised careful study of the merits of different varieties, thorough cultivation, spraying and manuring.

MINNESOTA CONVERTED.

DURING the recent meeting of the Minnesota State Horticultural Society, the great advantages of irrigation were acknowledged and advocated. In the Minnesota Horticulturist published by the Horticultural Society, appears the following, taken from the Minnesota Weather and Crop Review:

"Tile draining, subsoil plowing and irrigation are three conditions of good farming that the tillers of the soil in this State must learn to appreciate. The benefits of their adoption have been so universal that the intelligent cultivator must acquaint himself with them. When he has done so, he will not be slow to adopt them. The subject of irrigation is an old one, dating back 2,000 B. C. It is also a large one; whole volumes having been written on it. The simple fact is that seventy to ninety-five per cent of a growing plant is *water*, and that the solid portion of it can enter into it only in a soluble state. Hence, the first great need of all vegetation is *water*, the second is *water* and the third is *more water*. If this is not supplied naturally, it must be artificially. Nature has done her part well in Minnesota in that about seventy per cent of the total rainfall comes when most needed, during the growing season from April to September. The average precipitation during that time is twenty inches, fully seventy-five per cent, or fifteen inches, of which runs off and is evaporated, leaving only five inches available for plant life. You will see that this

amount is entirely too little, as twelve inches are required to carry a full crop from germination to maturity. As some practical results of irrigation, the writer has seen five crops of alfalfa "under the ditch" cut in one season, averaging two tons to a cutting; thirty-five bushels of wheat per acre from soil that had but one thorough wetting and no fertilizer; while in England sixty-five bushels per acre is a common yield from irrigated soil.

"Admitting the need of an artificial supply, the question arises, How large a stream will answer a given purpose? A stream one inch square flowing at the rate of four miles an hour will cover an acre one inch deep in twenty-four hours. Expressed in gallons, it is 27,245."

YIELDS OF CORN AND KAFFIR CORN COMPARED.

F. D. Coburn, Secretary Kansas Department of Agriculture, says: As the sorghums, and more especially the non-saccharine sorts, are attracting wide attention now the fact that Kansas is having a larger experience with them than any other State (232,498 acres in 1895, and likely to be doubled in 1896), brings innumerable requests from all points of the compass for information as to their characteristics, growth, uses and values compared with those of other crops raised for similar purposes.

The foremost of these sorghums in popular esteem appear to be the red and white Kaffir corn. For seven years, beginning with 1889, the Kansas Experiment Station, at Manhattan, has grown Indian corn and red Kaffir corn side by side for the purpose of testing their comparative yields of both fodder and grain. The following table, compiled by Mr. F. C. Burtis of the station, who has had an oversight of the work, shows an annual yield of each:

Year.	RED KAFFIR CORN,		CORN.	
	Grain per acre. Bushels.	Stover per acre. Tons.	Grain per acre. Bushels.	Stover per acre. Tons.
1889	71.00	9.00	56.00	2.50
1890	19.00	4.20	22.00	2.50
1891	98.00	6.00	74.00	2.95
1892	50.00	5.00	30.00	4.55
1893	49.00	5.25	30.00	1.75
1894	00.00	2.00	00.00	1.00
1895	43.07	1.53	22.76	1.64
Averages,*	55.01	4.71	x89.12	2.41

* Average of six years.

By this it is seen that the yield of Kaffir corn was very much larger than that of corn in five out of the six years, and the same as to the Kaffir corn forage every year. In fact the Kaffir corn yielded about 41 per cent more grain and nearly 95 per cent more fodder than the corn. The poor showing for both varieties in 1890 was due to a destructive frost September 12. In 1894 the failure of grain in both varieties was due to there being no appreciable rain from the middle of July to September 1, and the fact that the crops side by side on alternate plats were in a poor upland prairie soil underlaid with hardpan. Yet, under these adverse circumstances, the Kaffir corn yielded double the quantity of fodder that was obtained from the corn. As Mr. Burtis says, "Such dry weather kills the corn and it must then be cut, but the sorghums live on; although the growth may be checked the crop matures."

Mr. Burtis presents the further conclusions from his experience up to the present time: "For the combined purpose of raising the largest yield of grain and a fair quantity of stover, it is a fact beyond doubt that the red and white Kaffir corns are superior to any of the non-saccharine sorghums and the sugar (sorghum) canes. The latter will produce more hay or fodder, and of a little more palatable quality, than the Kaffir corns, and are preferred by many on account of this fact when hay or fodder is the sole object. Although there is a great deal said about which is the best, the red or the white, I believe when the proper comparison is made, the conclusion will show but very little difference, at least not as much as was first supposed. Aside from the color, there is a much greater difference between the different strains of the same variety than there is between the red and white varieties. A few who have kept their seed pure and carefully selected can testify to this when they have been, for some reason, forced to buy seed outside and got hold of some poor stuff. These sorghums are very susceptible to cross fertilization and modification, and there will be a rapid improvement or deterioration, according to the care that is exercised in selection of seed. Much of the Kaffir corn seed that is offered for sale is not the best. One may get as much difference in results from Kaffir

corn seed procured from two sources as between a very good variety of corn and a poor one."

IRRIGATING GRAIN.

IN irrigating grain experiment has shown that by proper care in the application of a sufficiency of water prior to the planting of the seed, enough moisture can be deposited in the soil to mature a crop in any ordinary season, supplemented as it is certain to be by more or less rainfall at intervals. Thus, while twelve inches of rain are considered the minimum sufficient to produce a normal crop, and fifteen inches are better, yet with thorough saturation beforehand, and a subsequent precipitation of no more than six to ten inches, an abundant yield may be relied upon.

In preparing land for economically irrigating wheat or other grain, the land must be so situated that it has a slight slope and water from a given source conducted over all portions of it at a moderate outlay. Suppose that the field to be irrigated be supplied from the northern side and that it has a slope both to the south and east.

From the ditch on the north plow shallow furrows running toward the south, at distances which must be determined entirely by the nature of the soil. There are soils where water will seep from fifty to two hundred feet and there are others where streams are required every fifteen to twenty feet. After plowing the leading furrows at right angles to the main ditch, plow another set parallel to it and at the same distance from each other as the first ones. This will have the effect of cutting up the field into a number of small squares. The furrows should be shallow.

Now turn the water into them and let it run, not in a flood, but in a steady flowing stream, filling all the furrows gradually, and overflowing over the soil into the next series. Let the water run a day or perhaps two days, depending entirely upon the nature of the soil. But keep it running steadily until the soil is softened to a depth of two feet or more and it is impossible to walk about without miring. Then shut off the water, let the saturated soil dry until it will hold up a team (this may take one or two days) and then begin plowing. Set the plows so that they will go in beam deep and do not be afraid of

stirring up the soil as deep as you can. If you desire you can go over the field and cross plow. When this has been done plant the wheat or other grain and you may depend upon it you will reap a goodly harvest with the assistance of even the minimum rainfall which is certain to come.

POINTS ON DITCH BUILDING.

In laying out your system of ditches use care and time.

See to it that the water can get off your land as well as on to it.

Run your ditch lines on the high parts of your farm as far as possible.

Make the grade as light as possible and avoid "siling up" or setting.

About four feet to the mile is what ordinary soils will stand.

It is better to have to clean the silt out of your ditches than to have them cutting away the sides or bottoms.

Cutting might be called "perpetual motion." If once begun it seems never to stop and the ditch gets lower and lower until you cannot get the water out of it.

A ditch should always be much larger than is apparently necessary.

When the ditch is completed let very little water in for the first few days and shut it off every afternoon. Watch it closely, for even with the greatest care in construction you will find that the ways of water in a new ditch "passeth all understanding."

Build the ditches broad and the banks broad and the cows can wander across the ditch without miring in its banks and starting out a little stream of water which in a few hours will cut away bank and ditch and perhaps wash a deep gash across the upper half of your field and bury an acre of wheat in the lower half.

No Cure as yet.—The Illinois Live Stock Association met at Springfield, during the session of the Illinois Farmers' Institute. A. J. Lovejoy, of Roscoe, member of the State Board of Agriculture and president of the Winnebago County Institute, read a paper on "Our Hog Interests." He claimed that the hog is the most important of all farm products, and gave many interesting figures. Regarding hog cholera, he said that as yet there is no cure for it.

His best suggestion was to take the well ones away from the sick ones, when the first symptoms appear. Place them at least sixty rods away, change the location often, use aconite to reduce fever; sprinkle the pen with carbolic acid; clean pen and burn bedding daily.

Fortunes in Cornstalks.—The possibility of making good syrup from corn-cobs has been established. Still another discovery is made. The Foos Manufacturing Company of Springfield, Ohio, has just completed special machinery to be used in the manufacture of cellulose from the pith of cornstalks. The product is the invention of Mark W. Marsden, of Philadelphia, and is to be used in the construction of United States men-of-war to prevent the inflow of water after the piercing of unarmored portions of vessels near the water line. Mr. Marsden states that a company with \$1,000,000 capital has been organized at Philadelphia to manufacture the product, and that a large factory is now in course of erection at Owensboro, Ky.

Cranberries.—There is no one more interested in the subject of irrigation than those who raise, or rather are trying to raise cranberries. For the past ten years it has been uphill work. Fire has destroyed most of our vines, and in many instances the land also. Last fall I put down three wells, and erected three wind-mills, which are doing good work, and it is my intention to keep them running all winter. It is too early to tell what the result will be, but it looks promising. My greatest trouble is in confining the water. During the winter and until about the first of June it is absolutely necessary to keep the vines under water. I have my ground surrounded with a strong embankment, but the water seeps through in spite of me. The soil is peat and sand. Ordinarily the water is about to the surface, but latterly it is anywhere from four to six feet below. When I put down my wells in October and November, 1895, I first sank a curb, made of two-inch plank, down to water, then put down a six-inch pipe to rock, about fourteen feet, and drilled into that some fifty feet. To the top of the pipe I attached an eight-inch iron cylinder

with a twelve-inch stroke; I believe my wells are inexhaustible by windmill power. Underlying the surface about four feet is a bed of solid heavy clay, from eight inches to one foot thick. Can you make any suggestions in *THE AGE* as to a cheap way of preventing the great loss of water? ARTHUR C. MILLS, of Wisconsin.

[Have any of our readers had any experience in growin cranberries? If so we would be pleased to hear from them.]

The Apple Worm.—The following is a brief life history of the apple-worm moth: There are two or more broods in California in a season. The moth in spring lays her eggs on the young apples, pears, and quinces after the blossoms fall. The egg hatches out a tiny worm which feeds at first off the skins of the young fruit and usually soon finds the eye or calyx of the fruit, and then burrows its way by eating directly to the core of the apple, where it feeds on the forming seeds and surroundings. In about thirty-three days it is mature and burrows a channel to the surface of the fruit, usually at the side, when it crawls down to the larger branches or trunk, seeking some shelter where it can hide and spin its cocoon, which is usually done in acute forks, or in cracks, or under loose scales of bark. Inside of the cocoon it changes in three days to chrysalis and then in eight to fifteen days comes out as a moth and is soon ready to deposit its eggs for a new brood of worms. No spray has been found of any use in destroying the apple worm except the arsenical poisons such as Paris green and London purple.

Refrigerators being far from satisfactory, the custom is growing of having an ice house and cold room combined, especially for fruit and dairy purposes. The Country Gentleman gives an illustrated description of one that has proven satisfactory in which the cold room is on a level with the cellar floor and the ice chamber with the kitchen floor.

No sawdust or other packing used on the ice which wastes about one-half during the season, keeping the cold room about 35° and preserves fruit perfectly from season to season. The drainage of ice is carried by V-shaped iron troughs between the

joists to one point. Ice does not rest directly on joists but on a bed of lath. Doors are fitted with rubber to close perfectly tight, and both should never be open at the same time.

Feeding Sorghum.—It is true economy to feed sorghum and broom-corn seeds where they are grown. The following table gives the digestible nutriments of different grains:

	Protein.	Carbo-hydrates.	Fats.
Sorghum Seed...	6.84	58.00	2.99
Broom corn.....	7.10	56.80	3.00
Wheat.....	9.50	60.90	1.90
Indian Corn.....	6.25	60.06	3.14
Oats.....	8.46	46.11	3.94
Rye.....	8.87	63.16	1.09
Barley.....	9.64	00.77	1.86

Showing that the two former are richer in protein, or flesh-forming material, than corn, and less carbo-hydrates and fats; indicating that for growing stock they are at least equal to corn but not equal to wheat, barley and oats. The grains being small and hard, they should be ground.

Oats.—Results of seven years' experiments with oats at the Illinois Station show that it is not advisable to plow after corn, the disc harrow causing better returns. Sow early and if broadcast two and a half to three and a half bushels per acre, covering no more than one to two inches. No one variety is greatly superior to all others. Neither color, plumpness, weight nor form of head certainly determine value, but generally varieties with long, slender, comparatively light kernels, have the smaller per cent of husk and probably greater feed value. Early varieties, harvesting before fully ripe, binding and shocking at once if in fit condition for cutting, are found to be preferable.

Salt is very beneficial to poultry; laying hens require it, as it has the properties of increasing the circulation of the juices of the body, thus favoring a greater protein assimilation. One ounce of fine salt daily to 100 hens, in shallow box that they shall not get too much.

Prof. C. C. Georgeson of Kansas Agricultural College, says recent experiments show that the disc harrow greatly improves failing pastures of natural grasses and

causes them to surpass in vigor of growth and tenacity of life any of the tame grasses that might have been substituted. "Southern Planter" says from an economic point of view there is no comparison between dry and silo feeding, and supports it with much evidence.

In spraying grape vines it is absolutely necessary that the right kind of spraying arrangement should be employed. A sprayer to be effective requires first of all a good strong force pump, next in importance is a nozzle that will throw a mist-like spray and will not clog when thick fluids are used. There are plenty of machines on the market filling all of these requirements.

In Egypt at least 50,000 pumps and water-wheels are in use. The power used for propelling these consists of wind and oxen. About 200,000 oxen are used in pumping water from wells that are shallow and dug after a crude manner. The water thus secured is used for irrigating crops of rice and cotton.

In the United States the average cost of raising water 100 feet by steam pumping, calculated from the reports of twenty-four cities, is \$3.55 per acre foot. Where the height to which water is to be raised is less, windmills and pumps can be employed at a comparatively trifling expense.

A half-acre fruit and vegetable garden, well cared for, is worth from \$100 to \$200 to any intelligent farmer's family. Give the boys and girls a chance to show what they can do as market gardeners.

The Farmers Alliance and Industrial Union of Colorado accuse Senator John Sherman and Daniel Voorhees of conspiracy and treason against the nation and the people they were elected to serve.

The soil must be fertilized and kept in good condition if the farmer expects it to yield abundantly. Crop rotation is one method of soil conservation, and it cannot afford to be overlooked.

Beet, radish, onion or other small garden seed should not be planted more than a quarter of an inch deep as a rule. Sweet corn should be covered to a depth of five inches.

American hens can produce as many eggs and as cheaply as any foreign hen.

An abundance of water for irrigation, and a warm dry climate, as nearly free from frost and fog as possible, is of more importance than soil in growing oranges.

Beans are a profitable crop, and there is always a sure market, as ship loads are imported into the United States every year from foreign countries.

Good roads are an absolute necessity. Why not introduce new systems and improved road-making machinery? The West needs better roads.

Don't neglect spraying the fruit trees for codlin moth, and also to prevent the birds from destroying the buds and blossoms.

The size and quality of a crop do not always determine its value. Transportation and market facilities must be considered.

Practical experience proves that a light wooden silo holds ensilage in its place well and robs it neither of heat nor moisture.

Every farmer should have enough pride in his farm and its surroundings to keep everything in a neat condition.

Planting time has arrived, and the ditches should now be cleaned and put in shape for irrigation.

Young turkey hens will lay early, provided they were early enough last year to get a good growth.

Farming is impossible without good working horses, no matter what the electrical experts may say.

Hogs when first up for fattening should have the amount of feed increased slowly and gradually.

Plant your prune trees about twenty feet apart. They will not thrive as well if planted close.

The value of oats, as well as the yield, will depend upon the preparation of the soil.

It is not the soil but the sunlight that makes a sweet grape and a perfect fruit.

The barley crop is a good spring grain with which to sow grass seed.

If you want pea straw, seed thick; if you want a crop of peas, seed thin.

Burn smutty corn at once.

MANUFACTURES AND TRADE

WHEAT does seem to have a "future" after all.

A FINAL survey of the Pecos valley railroad is being made.

THE millers, the dressed meats interest and various manufacturing interests urge Congress to restore the reciprocity treaties.

A RAILROAD is to be built from Colorado Springs to Cripple Creek which will place the great gold region within five hours of Denver.

THE National Pump Co. of Kansas City, Missouri, has been reorganized with a capital stock of \$50,000, to manufacture the Wonder pump.

AN irrigating pump with a capacity of 7,200,000 gallons every twenty-four hours is being built by the Pueblo Foundry and Machine Works. It will be the largest pump in Colorado and will weigh about 100 tons.

A CONGRESSIONAL committee is to investigate the immigration question at Castle Garden, New York, and we predict that as usual it will do nothing whatever to stop the flood of foreign paupers who are driving out honest American workmen.

THE latest official statement of the visible supply of grain is as follows: Wheat, 67,998,000 bushels, decrease, 947,000 bushels; corn, 7,647,000, increase, 1,493,000; oats, 6,615,000, increase, 246,000; rye, 1,554,000, increase, 22,000; barley, 3,246,000, decrease, 305,000 bushels.

THE memorials of the Chicago Live Stock Exchange and the National Live Stock Exchange, calling the attention of Congress to the discrimination made by foreign governments against the meat products of this country, and asking legislation relative thereto, have been presented and referred.

A BILL has been introduced in Congress constituting Andrew Carnegie, George A.

Kelly, Charles W. Batchelor, C. L. Magee, and twenty-six other persons a corporation, under the name of the Lake Erie and Ohio River Ship Canal Company, with power to construct and maintain a canal connecting Lake Erie and the Ohio river.

It is significant that President Baker's address, outlining the policy of the Chicago Board of Trade, contained no allusion whatever to option trading. The Elevator Combine and the bucket shops will be fought. President Baker is perhaps waiting to see what Congress will do about an anti-option bill. Many members of the Board are in favor of abolishing the gambling feature.

THE Crippen Lawrence Investment Company, of Denver, has been taken out of the hands of the assignee and reorganized. The Denver Land and Water Storage Company is also going to be reorganized. Austin G. Gorham, the receiver, is well pleased with the outlook. The company owns 17,000 acres lying southeast of Denver. The water for the land is stored in the famous Castlewood dam. These instances would seem to indicate better prospects for the various land, investment and irrigation companies that have been struggling along the past two or three years.

A BILL has been reported in the U. S. Congress for the appointment of a non-partisan commission to collect information and to consider and recommend legislation intended for the best interests of labor, agriculture and capital. The report which accompanies the bill states that in six years there has been a loss of \$34,000,000 to employers of labor owing to disturbed and unsettled conditions, and that this is but a fractional part of the real loss sustained by employers and employed and others whose interests are affected indirectly. The better labor is protected in all its rights, the better will be the security for earnings.

MINES AND MINING OUTPUT

DENVER has five mining exchanges; population, 164,000; altitude, 5,280 feet; area of city, forty-four and one-half square miles; 5,000 acres in parks; manufacturers' output, 1895, \$50,000,000; gold output, \$17,000,000; silver output, \$12,500,000; total mineral output, \$33,324,358.12; live-stock receipts, 402,148 head; death rate, 11.04 per 1,000; sun shines 315 days in the year.

As an exchange says, many wildcat mining companies are making a still hunt in the east, taking good care that there prospectuses and other advertising matter shall not be seen at home where their false pretenses would be speedily exposed. Eastern investors will do well to ascertain the home standing of a company before putting their money in it.

DENVER's fourth mining stock exchange will be known as the Denver Stock & Mining Exchange, and has a membership of 400, with the following officers: Thomas B. Stuart, president; J. R. Pratt and W. D. Wright, vice-presidents; John McMillan, secretary; and R. Mercy Anderson, treasurer. A fifth exchange has been organized recently.

The following is the world's output of gold for the years named:

1853.....	\$155,000,000
1874.....	90,000,000
1883.....	95,000,000
1887.....	106,000,000
1890.....	113,000,000
1893.....	155,000,000
1894.....	179,000,000
1895.....	203,000,000

THE Reform Press Association of Illinois has opened the columns of the papers controlled by its members to the silver party. In the resolutions adopted they state that they look upon the silver party as a friend and ally in the impending struggle between the masses and the classes.

J. J. Morr, chairman of the national committee of the silver party, has issued an address to the people arraigning the old parties for their financial attitude, and

calling on Americans who are patriotic to join in a concerted movement for the free coinage of silver.

THE Paris Economist says the stock of gold in European state banks has increased \$622,500,000 since 1890. At the end of 1895, the banks of France and Russia possessed gold representing half the stock of all the banks of Europe.

CY. WARMAN contributes to the Review of Reviews for February a very readable article on "The Story of Cripple Creek," illustrated by views of the camp and portraits of Messrs. D. H. Moffat and W. S. Stratton.

THE output of the DeLamar mine, in Idaho, for the year 1895, is stated at 43,680 tons of ore. Total receipts, \$935,899.57; expenses incurred, \$469,807.85; net profits, \$466,091.72.

THE Farmers' Institute of Camden County, New Jersey, was practically unanimous in declaring for free coinage, and sent a petition to Senator Teller to be presented to the Senate.

A project is on foot to construct a reservoir in Platte Cañon, Colorado, and use the water power to generate electricity which will operate an electric railway from Denver to Cripple Creek.

UTAH kept her reputation good as a silver and gold producing region during 1895, and toward the close of the year several very rich new strikes of gold were made.

The gold production of two great States is compared like this:

	1893.	1894.	1895.
California.....	\$12,538,780	\$13,363,282	\$15,500,000
Colorado.....	7,487,071	10,618,463	18,605,000

THE Beaver Hill Coal Company in Oregon are turning out 15,000 tons a month. The Colorado smelter, at Pueblo, is contemplating a change in the power plant.

THE DeLamar mines in Nevada have a capacity of sixty-five tons daily. Some new machinery, recently purchased, will increase the output to 200 tons.

THE creation of so many exchanges has opened the way for excessive speculation in stocks. The actual investor must be exceedingly cautious.

GEORGETOWN, COLO., produced 3,009 ounces of gold; 1,030,795 ounces of silver; 305,727 pounds of lead, and 3,315 pounds of copper in 1895.

THE Northwest Mining Association met in Spokane during February. Every mining town in the Northwest was represented.

GOLD-BEARING rock has been found on a mesa about four miles east of Las Vegas, New Mexico, but so far the assays have been low.

THE President has signed the bill opening the government lands in West Creek district, Colorado, for mineral development.

CLARENCE KING and party of Chicago capitalists, who own the Old Dominion mine in Washington, are inspecting it.

ORE receipts at Deadwood, So. Dakota, average 400 tons daily, with an average value of \$8,000 or \$240,000 a month.

THE "Great Falls Stucco Company" has been organized to bring out the gypsum deposits at Kibbey, Montana.

THE Ochoco Gold Mining Company of Chicago has been incorporated at Springfield, to mine gold in Oregon.

THE Governor of Arizona claims that State produced \$10,000,000 in gold in 1895 against \$4,000,000 in 1894.

The Big Cottonwood Power Company of Salt Lake City is putting in a 2,100 horse power electric plant.

TEXAS has not less than 20,000,000 acres of mineral land. The most abundant metallic product is copper.

THE projectors of the proposed smelter to be built at Galena, Kansas, have incorporated their company.

WATER ELEVATORS are becoming very popular in Nebraska, New Mexico and other Western States.

SAND on the sea beaches of Oregon contains gold, and wonderful stories are told of their richness.

THE total dividends paid by the Ontario Silver Mining Company of Utah amount to \$13,190,000.

ABOUT fifteen or twenty mining companies are being organized every day in Colorado.

THE Cedar Vale (Kansas) Mining Company are mining for gold near Orlando, Oklahoma.

It is predicted that before midsummer Cripple Creek will have a population of 75,000.

A DISCOVERY of opals has been made on a tributary of the Big Camas Creek in Idaho.

THERE is more activity in lead and zinc mining at Galena, Kansas, than ever before.

THE People's Party of Massachusetts has declared for silver coinage at sixteen to one.

THE assay office at Boise, Idaho, recently shipped \$32,257.32 in gold in one day.

CINNABAR was lately found in paying quantities near Great Falls, Montana.

QUICKSILVER has been discovered a few miles from Snohomish, Washington.

THE great smelter at Spokane, Washington is to start up immediately.

AN organized movement is on foot to develop Montana's iron mines.

CRIPPLE CREEK still continues to be the principal feature in Colorado Mining.

NEW Mexico is beginning to feel the effects of the mining activity.

THE pay roll for labor alone at the Butte camp is \$800,000 per month.

THE big shaft of the Anchoria-Leland mine is being sunk rapidly.

NEW rich strikes are being reported almost daily from Colorado.

THE rush to the mining fields of Alaska is just beginning.

A NEW chlorination mill is proposed for Cripple Creek.

ST. LOUIS and Boston also list Colorado mining stocks.

MINE-SALTING is not so successful as it used to be.

PARTIES from Alaska tell of a gold-bottomed lake.

IRON MINES are being opened at Jefferson, Texas.

COAL is being mined at Enterprise, I. T. BUTTE has no mining exchange.

THE PROGRESS OF WESTERN AMERICA

IRRIGATION FROM THE GREAT LAKES.

ONE cause of anxiety concerning the lake levels is the immense "Drainage Canal" from Lake Michigan, at Chicago, through a portion of the State of Illinois. But the "Drainage Canal," with its great drainage on Lake Michigan, is really a merchant-ship canal which provides another water route to and from the Atlantic, this time via the Mississippi river, and it cannot be interfered with. By this route, American men-of-war can come up to the lakes. Congress will look after the lake levels and, by a system of immense dams in different locations, the level of the lakes will be kept sufficiently high so that the stage of water at the shallowest points in connecting rivers (with additional dredging and rock blasting) will be deep enough for the largest and deepest lake carriers. This ship canal is really a National institution, and in case of war would be all-important, as it will at all times be to the commercial world. There is a secret about this great project which may now be let out. For years old residents of Chicago labored for it, but, under the name of "a ship canal, to connect the lakes with the Mississippi and the Atlantic," the masses refused to expend the millions necessary. The matter was allowed to drop out of the public mind for a few years, and a seemingly brand new project of "a great drainage sewer for Chicago" was then broached, and it went through with a rush. Now Chicago has her drainage sewer and the nation has a great ship canal, and the dear people are benefited even against their own sweet will.

And if a ship canal, or a drainage canal, why not an irrigation canal? As the safe and sure (the irrigation) plan of farming grows in Illinois, it will suggest itself to the agricultural classes that this "Chicago Drainage Canal" can be tapped, and that other, special, irrigation canals can be

built, and so it will go until Illinois has a system of irrigating canals. And if this can be brought about in Illinois, then every State having a lake front can follow her example.

Irrigation is being adopted generally in the central West, and in the Eastern and Southern States, and the people will go any length to obtain water. In a word, the agriculturists seem to have suddenly awakened to the fact that the element of uncertainty can surely be removed from their industry and that the means to this end is irrigation. Located on fertile soil, they are tired of losing a crop every other season, while farmers on arid lands in the far West have a certainty of several crops every season.

For the present the central Western States just resorting to irrigation—Illinois, Wisconsin, Indiana, Michigan, etc.—will confine their operations mostly to the orchards and the garden vegetables, and wells, pumps, and reservoirs will be the means of obtaining and accumulating water, but sooner or later the lake States will be watered from those great fresh water lakes, and there will be water enough obtainable to insure the safety of all the great staple crops.

LIVE STOCK INTERESTS.

Samuel W. Allerton, one of the large pork packers of Chicago, is in Washington in the interest of live stock growers, shippers and traders. At a recent meeting of the representatives of the Live Stock Exchanges of Omaha, Kansas City, Sioux City, Buffalo and Pittsburg, it was determined to petition congress in regard to the re-establishment of reciprocal relations with foreign countries, so that cattle and hogs could be sold to advantage. Communications were addressed to the members of the Ways and Means Committee, and a hearing has been accorded the representatives of the National Live Stock Exchange. We shall go before the sub-

committee on reciprocity, of which Congressman Hopkins of Illinois is chairman, and state our case and urge prompt action by Congress at this session.

Mr. Allerton said: "It is all well enough to talk about a restoration of the tariff, but no relief from such a source can be obtained inside of six months. On the other hand, if we can renew our former relations with Germany, Belgium, Switzerland and other European countries, so that our cattle may be sold there, the benefit will be instantaneous. This point will be impressed upon the Ways and Means Committee, and I do not see how this body can fail to act promptly upon a matter which is so vital to the interests of the United States."

Governor McIntire, of Colorado, has issued a proclamation establishing a quarantine against cattle and horses from California, Texas, and the territory of Oklahoma, and other States and Territories lying south of the thirty-sixth parallel of north latitude, and prohibiting their admission to the State except upon certificates of the Veterinary Sanitary Board or their duly authorized inspectors.

Governor Rickards, of Montana, has issued his proclamation prohibiting the importation of sheep into Montana from Oregon, Nevada, California, Washington, Wyoming, Idaho, Colorado, Utah and Territories of Oklahoma and New Mexico.

There were 14,000 head of cattle in the Kansas City yards about the middle of the month.

A co-operative creamery association has been organized at Darien, Wisconsin, that will erect one of the finest creameries in the State. The charter has been secured and officers elected as follows: L. E. Hastings, president; M. E. Cusack, manager; M. H. Gardner, secretary; B. J. Blakely, treasurer; Frank Randall, John Piper and Clarence Mereness, directors and building committee.

The Western Packers' Canned Goods Association of Chicago has elected L. G. Seager, president; J. S. Edwards, Leavenworth, Kansas, secretary and treasurer.

At the Indiana Congress of Industrial Associations, composed of the organizations engaged in the promotion of agricultural pursuits, Governor Matthews

urged the establishment of a midwinter stock show to be held in connection with the Chicago show.

The Kansas City Cattle Company has received a charter from the State of Kansas, and will engage in the cattle business on a large scale.

The Union Stock Yards, at Sioux Falls, So. Dakota, has incorporated with \$1,000,000 capital stock.

The South is at present affording a fair market for horses.

Commission men have taken up the fight for live stock shippers against the switching charge of \$2 per car levied on all stock by the railroads in Chicago, and the case is before the Illinois Railroad and Warehouse Commission.

At the annual convention of the National League of Commission Merchants of the United States, in St. Louis, it was resolved that the commission men of the country were the representatives of the producers, and that they must see to it that producers get fair transportation rates and fair treatment as regards a saving of time in shipments and proper handling of the products. A firm stand against the railroads was decided upon.

GOOD ROADS.

Good Roads Parliament, at its last session, held at Atlanta, Georgia, heard reports from thirty-two States relative to the progress made in the construction of roads, and as to legislation concerning good roads. The United States government had constructed on the Exposition grounds four classes of roads, and the afternoons during the session were spent in seeing the roads tested. The members of the Parliament also witnessed the construction of an improved road by convict labor, engineering skill and improved machinery. There were exhibits of road material from all sections of the Union. The officers of the Parliament, as elected, are: President, Gen. Roy Stone, Washington, District of Columbia; first vice-president, Judge W. F. Eve, of Georgia; second vice-president, Hon. J. A. C. Wright, of New York; secretary, W. G. Whidby, of Atlanta, Georgia; assistant secretary, J. S. Rogers, of New Jersey. The next meeting will be held at Nashville during the Tennessee Centennial Exposition.

Congress and the Legislatures are respectfully reminded that the farmers, the bicycle riders (embracing about half the population of the country) and the bicycle manufacturers (representing many millions of dollars) are a unit in demanding good roads in every State in the Union.

IRRIGATION REPORTS.

In the list of irrigation reports that appeared in the January issue of *THE AGE*, by an oversight two of the earlier ones were omitted. They are as follows:

Report of the Board of Commissioners on the Irrigation of the San Joaquin, Tulare and Sacramento Valleys of the State of California, by Lieut.-Col. B. S. Alexander, Major G. H. Mendell, and Prof. George Davidson. Washington Government print, 1874, pp. 90 and maps. Only 500 copies printed and now scarce. And a report on the Irrigation and Reclamation of Land for Agricultural Purposes as now practiced in India, Egypt, Italy, etc., by Prof. George Davidson. Washington Government print, 1875, pp. 70 and maps. 500 copies printed and now scarce.

Mr. H. M. Wilson says, in his paper on American Irrigation Engineering, p. 138, of these two reports that "they are two of the mile-posts which mark the awakening of the people of California and the country at large to the subject of irrigation and the necessity of learning the best methods of practicing it."

A LUMBER TRUST.

The lumber interests of the Pacific coast have consolidated. The Central Lumber Company of California, recently organized, controls \$70,000,000 of capital invested in lumber mills, timber lands, vessels and plants. It comprises practically all mill and ship owners and every wholesale and retail dealer on the Pacific coast. The price of lumber has been advanced \$2 a thousand feet already.

KANSAS.

The Valley State Bank of Hutchinson, Kansas, suspended February 11.

There are forty-five windmill irrigation plants around Larned, according to E. E. Frizell.

John Edwards, of Larned, says the great need of the Pawnee valley is a canning factory.

Kansas lawyers are trying to have the State divided into two districts, each with a United States District Court.

W. B. Sutton of the Kansas State Board of Irrigation is very enthusiastic in regard to the reclamation of the great plains by means of pumps and windmills.

Prof. A. R. Taylor of the Kansas State Normal School is in Washington trying to get Congress to pass a bill appropriating part of the revenues of public lands to the support of all State normal schools in the United States. He is also trying to aid in securing the passage of the Fort Hayes bill, by which the State Normal School of Kansas will be much benefited.

The State Board of Irrigation of Kansas has practically determined to locate an irrigation plant at Hoxie and another at Wallace. These plants are a part of the seven remaining under the act of the Legislature to be located. Chairman D. M. Frost of the Board has been making some tests of the underflow near Garden City. By means of a pump, with a six-inch supply and four inch discharge pipe, he pumped 600 gallons of water per minute from the well. Experiments will be made by the Board for the purpose of discovering whether or not it is possible to exhaust the underflow in that well.

H. V. Hinckley, of Kansas, the well-known authority, presented an excellent paper at the recent session of the Kansas State Board of Agriculture upon the subject of "Underflow as Related to Irrigation Development." He said the residents of the plains are entirely correct in their view of the underflow—that it does flow—and insisted that too many canals have been built where reliable water supply is not a surface supply. Pumping plants and gravity developments of the underflow furnish reliable supplies which can be guaranteed in advance of the investment, whether a few thousand or millions of gallon a day.

The name of the Kansas Mutual Life Association has been changed. The organization will hereafter be known as the Kansas Mutual Life Insurance Company. This action was taken at a meeting of the Board of Directors in February. This institution has entered upon the fifteenth year of its business career. The present officers of the company are as follows: President, John P. Davis; vice-president, W. M. Welcome; secretary, John E. Moon;

assistant secretary, W. B. Kingsley; superintendent of agents, F. E. Marsh; medical director, Dr. S. E. Sheldon; actuary, C. G. Blakely; counsel, R. T. Herrick. The Board of Directors is as follows: E. N. Morrill, John R. Mulvane, W. M. Welcome, John P. Davis and John E. Moon. The members of the Advisory Board are as follows: T. B. Sweet, Jonathan Thomas, Edward Wilder, E. H. Snow, Geo. M. Noble, Thomas Page, Charles Wolff, H. E. Ball, P. I. Bonebrake, Samuel T. Howe, Willard N. Hall, Geo. W. Crane, C. R. O'Donald, H. A. Heath, Josb Mulvane, James A. Troutman and Charles S. Gleed.

NEVADA.

In past years comparatively little interest has been taken in the irrigation question in Nevada as a factor in the upbuilding of the State, but recently, and as the people have grown to appreciate her agricultural possibilities, several large irrigation enterprises have been discussed, but as yet none of these have progressed beyond the initial stage, though one or two at least, promise to be carried out in the near future.

The most notable of these is a project to utilize the water of the Humboldt river, supplemented in the latter part of the season by stored water, to reclaim some 60,000 acres of fine alluvial lands on the north side of the river at Battle mountain. At this place storage can be accomplished and canals constructed so cheaply, that if the enterprise shall be carried out as at present planned, the land, with water delivered and water right free and perpetual, can be sold as low as \$10 per acre and still yield a profit of 100 per cent on the investment.

At Lovelakes, near the lower end of the Humboldt valley, about 1,500 acres of new land will be brought under irrigation and cropped this year. S. R. Young, of that place, is pushing work on his canal which is designed to supply water to some 4,000 or 5,000 acres of land not now under ditch, and hopes to have it completed before the end of the year.

In Carson valley, Mr. Newlands, representing the Sharon Estate, is prepared this year to supply water from his reservoir, constructed in 1895, to some 3,000 or 4,000 acres of new land.

From every county in the State come reports of developments, both agricultural and mineral, and of increase of population which, though not great, indicate that the period of decadence of the Sage Brush State is past, and that she is already entering upon a new era.

SO. DAKOTA.

At the meeting of the executive committee of the So. Dakota Immigration Association in Aberdeen, recently, it was decided to take up the matter of irrigation and immigration in an active manner. The committee represented all parts of the State.

The dates for the irrigation convention at Redfield, S. Dakota have been changed to March 4 and 5. The call was issued by State Engineer of Irrigation Baldwin.

R. M. Springer is organizing a company to irrigate South Dakota lands with artesian wells.

NEBRASKA.

The late irrigation convention, at Sidney, seems to have given a great impetus to irrigation in that vicinity. This same result has followed the holding of these conventions at other points in the State. Many district canals are now projected, and a number of the canals completed or nearly completed will be converted into district canals.

The great underground flume, near Sutherland, that carries the water of the North Platte across and under the South Platte river has so far proven a success.

The farmers of Nebraska are generally adopting the windmill system of irrigation, and windmill plants are now to be seen all over the State. At a late meeting of the State Horticultural Society, at Lincoln, the question of irrigation was discussed to a great length. I. A. Fort read a paper on Irrigation for the Orchard and Garden, stating what had been done in Nebraska on these lines.

The State Irrigation Immigration Society held its first meeting in the Capitol building in Lincoln, on the 14th of January, to perfect arrangements to promote immigration to the irrigable lands of the State.

North Platte will hold a Western Nebraska Fair at some time during the com-

ing summer. They propose to show what irrigation can do for the State. The fair will immediately follow after the Lexington Irrigation Convention. Hon. W. F. Cody's Wild West, will arrange to exhibit during the fair week, as the show will be en route to the Pacific coast at about that time, and the show will again exhibit in the town that gave it birth.

The farmers who are using farm mills for irrigation purposes are making complaints that they have not sufficient strength to stand the strain that comes from working the extra large and heavy pumps that are used for this purpose. Extra heavy strong mills, like the Aermotor, are needed.

The district canal promoters are waiting in suspense on the decision of the U. S. Supreme Court on the validity of the Wright Act.

WESTERN PUSH.

Seattle, Washington, is to have a new water supply, for which \$1,250,000 was voted in December.

It has been learned that the contract for building the big irrigation canal through Fort Hall reservation, in Idaho, is good, in spite of the protest made by the Indians.

"Indian" Jones, of Utah, has gone to Washington with a monster petition in favor of opening a portion of the Uintah Indian reservation.

A new industry is being developed in Orange County, California, that of manufacturing oil from eucalyptus leaves, which is being used extensively for medicinal purposes.

Prof. George Davidson, of California, has just finished an examination and report upon the nearly completed project of the Stanislaus and San Joaquin Irrigation Co., a project that proposes to irrigate some 200,000 acres of land in the neighborhood of Stockton in the San Joaquin valley. They take their water from the Stanislaus river above Knight's Ferry, and take it seventeen miles to the plains. They have put up some good flumes, one 2,400 feet long in two sections of 1,200 feet each, and ninety feet from the ground to the bottom of the flume box.

MINERAL WAX.

The true mineral wax was discovered thirty or forty years ago in Eastern Utah, on Howland mountain, in the Pleasant valley country, says the Mining Industry, and in other districts in Utah. It was the true ozocerite and was named *utahcerite claytonia* by and after Professor Clayton, of Salt Lake City. It corresponds to the paraffine that is obtained as a product of the petroleum refineries of Pennsylvania, and which is used in the manufacture of candles and for a variety of purposes. The native article has not yet been found in this country in quantities sufficient to make it pay. In the raw, some ten years ago, it was quoted worth \$800 per ton. The principal mines are in Galicia, Austria, where the deposits are large, and the mining of it is done by women and children. True ozocerite is a lustreless black and melts in the sun's rays. It is very light, burns at high temperature and is odorless. Nearly all the candles of the Greek Church in Russia are made of ozocerite, which is refined and bleached to nearly a transparent whiteness, and the candles are hand-painted with flowers and religious symbols. As a by-product the ozocerite yields cosmetics, dyes, gas and a score of other articles, and if a prospector is ever lucky enough to strike a large deposit in Utah or Wyoming, he will have a good thing. For several decades of years the Galicia mines were supposed to be the only ozocerite mines in the world, but of comparative recent date a discovery was reported in Egypt and somewhere in South America. The Pleasant valley mines were developed, but the ozocerite at depth gave place to asphalt and minerals of kindred nature. The ozocerite is most likely to abound where salt beds and coal or petroleum are in contact.

An exchange from that State says: "The new dispensation for Western Nebraska is based largely upon the windmill. To be able to pull through from one year to another, through thick and thin, is the one thing desired for the pioneer. With water for but a few acres this consummation is reached."

FLOUR MILL.

A flour mill is needed in the Pecos valley. Strong inducements are held out to an enterprising miller.

THE EDITOR'S DRAWER

PUEBLO, COLORADO, has a population of 38,000.

THERE is still money in high-class, thoroughly broken carriage horses.

THE fifth session of the National Irrigation Congress will be held in Phoenix, Arizona, early in December, 1896.

THE Pottawatomie tribe of Indians in Southwestern Michigan will have \$104,-000 distributed among the 240 surviving members.

THE new officers of the Indiana State Board of Agriculture are: President, W. W. Hamilton; vice-president, James E. McDonald; secretary, Charles F. Kennedy; treasurer, E. J. Robinson; executive committee, Aaron Jones, Charles Downing, V. K. Officer.

AFTER all, Max O'Rell is something of a wise man. When he said that the reason the sun never sets on the British Empire is because the great orb cannot trust an Englishman in the dark where there is any land he can possibly covet, he hit the nail on the head.

How to stop the adulteration of extracted honey was one of the subjects vigorously discussed at the recent meeting of the Illinois State Bee-Keepers' Association, in Chicago, and it was decided to ask that a law be passed by the State Legislature and also by Congress.

OFFICERS elected by the Illinois Grange were: Worthy Master, Oliver Wilson, Putman county; overseer, S. G. Atwood, Winnebago county; lecturer, Alexander Kedy, McLean county; chaplain, T. J. Crowder, McLean county; steward, J. W. Whitson, Schuyler county; assistant steward, J. E. Siler, Wabash county.

CHEAP newspapers continues to be the watchword. The New York World, probably the greatest newspaper on the continent, has just reduced its price to one cent a copy. In announcing this change it states that it is the intention to set up a standard as to how much a newspaper can give for one penny and not how much can be charged for a minimum amount of news and information.

A CALL has been issued for a meeting of the Farmers' Alliance and Industrial Union of Kansas, to be held in Topeka, on April 9, 10, and 11. The meeting is for the purpose of organizing a State Co-operative Congress, and representatives from every co-operative association in Kansas and elsewhere are invited to attend and discuss practical methods of co-operation. The call is signed by A. Wardall, president, and S. D. Cooley, secretary.

CHAIRMEN of standing committees in the Illinois Farmers' Institute are as follows: Agricultural Education, Prof. Eugene Davenport, Champaign; Agricultural Advancement, Col. J. W. Judy, Tallula; Education of Farmers' Children, S. M. Inglis, Springfield; Dairy Husbandry, John Stewart, Elburn; Horticulture, T. E. Goodrich, Cobden; Live Stock Breeding, J. M. Thompson, Joliet; Finance, F. M. Palmer, Clinton; Transportation, C. F. Mills, Springfield.

AMONG those present at the session of the Illinois State Bee-Keepers' Association, in Chicago, were: President C. C. Miller, Merino, Illinois; E. R. Root, Medina, Ohio; W. J. Finch, Jr., Springfield, Illinois; J. Roorda, Thayer, Indiana; M. M. Baldrige, St. Charles, Illinois; Mrs. N. L. Stowe, Evanston, Illinois; W. Blume, Edison Park, Illinois; George Thompson, Geneva, Illinois; Christian Schrier, Peotone, Illinois; A. N. Draper, Upper Alton, Illinois; W. C. Lyman, Downer's Grove, Illinois.

THE following officers of the National Reform Press Association were elected for the present year at the fifth annual convention held at Dallas, Texas, in February: President, Paul Vandervoort, of Nebraska; vice-president, Frank Burkett, of Mississippi; recording secretary, C. Rosell, of Missouri; corresponding secretary, J. A. Parker, of Kentucky. Executive Committee, J. H. Ferris, Illinois; Charles X. Matthews, Indiana; S. Peters, Texas; Abe Steinberger, Kansas; Miss Mary E. O'Neill, of Missouri, editor of Reform Ready Printer; W. S. Morgan, of Arkansas.

TOPICS OF THE TIME

The Southwest Repudiated. The Territories of New Mexico and Arizona have been denied admission to the Union as States. Not a straightforward, outright denial, but an equivocal put-off-do-nothing policy has been adopted. Can the United States Congress afford to continue on this line? Are these two great territories of the Southwest to be denied the privileges of statehood because the do-nothing policy politicians do not wish to have the West adequately represented for fear that the silver cause would be strengthened by the addition of four senators? The population of these territories is sufficiently large to meet the requirements, in fact it is larger than that of many of the States when admitted to the Union, and the people are of an energetic, enterprising character. The mineral wealth is practically unlimited, consisting of vast deposits of gold and silver and other ores. The agricultural interests, while yet in their infancy, have attained a sturdy growth and are being developed rapidly. The Pecos valley, in Southeast New Mexico, is a notable instance of what can and has been accomplished in this direction. The earnings from the live stock industry amount to millions of dollars annually. The natural resources and possibilities, the material wealth and the population are the claims which should justly entitle these Territories to a place in the Sisterhood of States. Will they be recognized?

The Mining Boom. The mining activity of the West has steadily increased during the winter, and present conditions would seem to indicate that the spring and summer will show an unusual amount of work in this line, in fact it is assuming the nature of a boom, and already the conservative men are beginning to deprecate anything tending to increase the excitement. The name of Cripple Creek has been the talisman that has charmed every body and drawn them toward it like a magnet. The rich strikes in this district have

led to active development work in every district in Colorado and the fever has spread throughout the Western States. In the February Review of Reviews, Carl Snyder predicts a flood of gold, basing his conclusions upon the greatly increased production of the yellow metal in the last few years. Even admitting that his estimates of the output in the years between 1896 and 1900 are correct, there is no danger of a glut of gold. The world has never had sufficient metal money with which to carry on legitimate business. But without enlarging upon this view of the matter there is a danger which must be faced and overcome or it will work untold harm, not only to mining, but to every other interest in the West. It is the tendency to BOOM. There have been too many booms. The best interests of every Western State demand a preservation of the confidence of the investor. A boom will attract only sharks and speculators. Actual development and a steady (if slow) growth will invite the confidence of men and money and result beneficially to every interest.

Its Effect on Other Interests. There is another phase of the mining question that has as yet been touched upon but little. It is the effect it will have upon the agricultural development. The miner must be fed, pork and beans are as necessary (if not more so) than gold ore a hundred to the ton. The great stream of men now pouring into the mining camps will consume hundreds of thousands of dollars' worth of the products of the farm and the factory. The farmers and fruit-growers, the cattle-raisers, the manufacturers and merchants can all prepare for more prosperous conditions and a better market. As for the railroads—it is said that one line running into Cripple Creek is clearing \$50,000 a month.

Now is the time for the land and irrigation companies to put forth their best efforts, providing they are dealing honestly with their patrons. Many inducements

can be held out to the prospective settler who desires a home and a living for himself and family. On a few acres of irrigated land they are in no danger of starvation and there is no reason to complain of lack of market for the surplus product.

A "In the City of Washington *Foreign Critic* actually entertained about the West and its resources, while in Austria I think we can tell you the population of Denver." Such was the expression of Baron Von Hengelmuller, the Australian ambassador, while on a western trip in February. What a commentary on the American people and their ways! Should we be obliged to wait for the representative of a foreign nation to come here and tell us that we know less about our own country than the inhabitants of Europe? Will the East ever get an accurate conception of the West? Will it ever fully realize that west of the Missouri river, omitting Alaska, lies a country, not only larger in extent than all of Europe, excluding Russia, but greater in natural resources than any other section of the globe? Will the Eastern Senators and representatives in Congress stop dickerings about a post-office in Podunkville and give a few

minutes of their valuable (?) time to the consideration of irrigation and western development, or will the members of Congress from the Western States drop partisanship and private enterprises for a while and become a unit in insisting that the recognition to which it is entitled be accorded the larger portion of the country?

What Kansas again in the saddle. It does *is Doing*. not purpose to sit idly by and watch the tide of immigration flow into other sections without an effort to stop a portion of it in the valleys and on the prairies of the Sunflower State. The Kansas Immigration and Information Association has been formed for the purpose of disseminating reliable information relative to the agricultural, commercial, manufacturing and mining interests of the State. W. C. Edwards, the Secretary of State, is the president and moving spirit, and Frank D. Taylor, secretary. In the hands of such efficient men the movement cannot fail to be a success, and it is being seconded by Gov. E. N. Morrill, Col. John E. Frost and many other leading men. Already public meetings have been held in Illinois and Indiana, and arrangements for others are being made.

COMICALITIES.

A BIRD that can't sing, and will sing, should be made into a pot-pie.

THE YOUNG man just out of school advertises for a "position," but after six months of hustling he is mighty glad to get a "job."

"THIS is the biggest jump on record—a Providence man has jumped the State."

"Oh, pshaw! that's only Rhode Island! Now, if it had been Texas—"

HANK BITTERS.—How are you goin' to the masked ball tonight, Ike?

ALKALI IKE.—Thought I'd keep sober and—

HANK BITTERS.—That's disguise enough, nobody'll know you!

TEXAS JACK.—I guess we'll have to run that tenderfoot bank cashier out of town!

BRONCHO BILL.—What for?

TEXAS JACK.—You know the last feller we strung up for horse stealin'? Well, that cashier actually wanted the man identified first!

MR. ISAACS (*at the skating rink, excitedly*).—S'hellup me Fadder Apraham! Dat poy vas neffer learnt nuttings. He neffer vill get de vort' of his moneys, any dimes.

MRS. ISAACS.—Vat's der matter, Fadder?

MR. ISAACS (*in agony*).—Vy, schoost look at him! I bays me feefty cents fer him to skate on der ice, and he goes apout on von foot most of der dimes.

TENN DE FOOTE.—I heah they give a man plenty of chances in the West.

COL. YELLOWSTONE.—Well, it depends on what he has done. Ordinarily he has a chance with the vigilantes, and a chance with the judge, and a chance with the jury—even after that he has a chance of the rope being shot in two before life is extinct.

"How did you like it in the West?"

"Not very well. It took too much attention to find out just when to throw up your hands and when to lay down your hands."—*All from Puck.*

MACHINERY AND APPLIANCES

BUILDING CANALS CHEAPLY.

The New Era grader and ditcher, and its predecessor, the Wauchope, have been in use for nearly twenty-five years, and have always given satisfaction. The New Era is designed especially for building large irrigation canals, railroad embankments and levees. The chief points in its construction are as follows:

The plow is constructed to stand as great strain as any plow moved by horse power; and by draft chains, gauge wheel, guide arms and elevator chains, is easily controlled by the operator.

The carrier is built in four sections and, by bolting together the various parts, will carry and deliver earth at fourteen, seventeen, nineteen or twenty-two feet from the plow, or if necessary can arrange for twenty-four-foot delivery, or at its extreme length, at a height of eight feet above the plow. The transverse carrying belt is of heavy three-ply rubber, three feet in width, and arranged so it can be readily and quickly changed in length. It is moved upon a system of rollers in the carrying frame by a drum at the outer end of the carrier, driven by a strong gearing attached to a heavy steel shaft, which constitutes at once the rear axle of the machine, as well as the propelling power of the carrier, by means of the broad rear wheels, which are ratcheted at each end.

The truss work is broad and low, covering eight feet in width by fourteen feet in length, exclusive of the long carrier.

This enables it to work on steep hill-sides, where any wheeled implement can be used, and as the front wheels are low and turn under the truss work, the machine is very readily turned in much less time and space than required for a lumber wagon.

The New Era is built with its various parts, severally and collectively, of the requisite strength for endurance in the many kinds of work to which it may be subjected, with a minimum of wear and breakage, and while supplied with every

necessary mechanical device essential to its many uses, it is yet so simple in its construction that any man of ordinary intelligence readily comprehends its management, and with brief experience can successfully operate it.

The working force necessary to operate the New Era is twelve horses and three men. Eight horses are used in front; four abreast, guided by one driver, and four are driven behind on a push cart and controlled by a second driver, while the third man, who usually acts as foreman, governs the working of the machine.

The cost of moving earth in great quantities by means of the New Era grader is reduced to a minimum.

For smaller ditches and road making the Austin Steel Reversible machine will do the work rapidly and cheaply, and better than can be done with plows and scrapers.

The F. C. Austin Manufacturing Company, of Chicago, who manufacture the New Era Grader and Reversible machine, also make rock crushers, street sweepers, sprinklers and rollers, contractors' plows, wheel and drag scrapers, tubular truss bridges and well-making machinery.

Catalogues, price lists, and special information will be sent upon application if *THE IRRIGATION AGE* is mentioned when writing. See advertisement on inside back cover.

ACCORDING to the United States census there were in June, 1890, upon farms, 8,097 artesian wells. Three thousand nine hundred and thirty wells were employed in irrigation, watering 51,896 acres, or an average of 13.21 acres per well. Over one-half of these wells were in California. The average depth of these wells was 210.41 feet and the average cost \$245.58. The number of wells and the acreage irrigated has been very largely increased since the taking of the census. This is especially true of South Dakota, where for the time being all other interests seem to be subordinated to irrigation by means of artesian wells.

ELECTRIC POWER PAPER MILLS.

The Cliff Paper Co., of Niagara Falls, are building a new power house, in which they will generate electricity for use in their paper mill. This paper company has a pulp mill, driven by two Leffel Wheels, of 2,500 horse power, at the water's edge below the falls, and a paper mill on the top of the high cliff, thus securing a double service from the water. This double use of water is quite an innovation, and has brought discredit upon the saying that "The mill will never grind with the water that is passed." Now, this progressive company is about to take another step to practice economy, and it will adopt electricity, to succeed steam, to run their paper machines. When this proposed electric plant is installed, it will drive out three steam engines of over 200 horse power. Preparatory to the adoption of the electric current, this company will build a stone power house, 20 by 30 feet in size, close to their pulp mill. The penstock leading to the pulp mill will be tapped, and a portion of the water diverted to run a 250 horse power James Leffel turbine, to which will be attached two 125 horse power generators. At the top of the cliff will be two electric motors, of 100 horse power each, attached to each of the paper machines; besides there will be two motors of five horse power each, to furnish power for the small machinery about the mill.

The tenth annual State Farmers' Institute, with Superintendent George McKerrow, of Madison, in charge, will convene at the City of Watertown, Wisconsin, from March 10 to 13. A large number of institute workers from the Northwestern States and Canada have signified their intention of being present, with a view to effecting an international organization. This will close with a convention of prominent institute workers.

MARIA.—I tell you, Joshua, this is the kind of man that I like to see elected.

JOSHUA.—How's that?

MARIA.—Well, instead of cavortin' raound tellin' w'at he'd deu, the paper says he just staid to home and "mended his fences."—Puck.

W. W. MONTAGUE & CO.

MANUFACTURERS OF ALL SIZES

FOR
Irrigating, Mining, Power Plants,
Artesian Wells, Water Works,
Town and Farm Supply.

SINGLE AND DOUBLE RIVETED

WATER PIPE

Made in Sections of any Length Desired
12 to 28 Feet.

The Cut on the left shows a section of Five joints
of pipe.

DOUBLE RIVETED IN LATERAL SEAMS.

Particular attention is given to Coating Pipe
with our "EUREKA" Composition, a Special
Mixture containing No Coal Tar. Iron Coated
with this Composition is Rust-Proof and Rendered
Impervious to the Alkalies of the Earth, is
Practically Indestructible.

Iron Cut, Punched and formed for Making Pipe
on the Ground where required.

309-317 Market St., San Francisco, Cal.

OWN YOUR OWN WATER SUPPLY.

YOU CAN DO IT WITH A

MENCE PUMP

Simplest and
Lightest Running
Pump.

No Valves, Glands,
Stuffing Boxes or
Joints; nothing to
get out of order; 25
per cent. more work
guaranteed over all
pumps with same
power. Over 2,000
now in use.

SEND FOR CATALOGUE

Not affected by
freezing.

JOS. MENGE,

105 Tchoupitoulas Street, NEW ORLEANS, LA.

WRITE FOR PRICE S. AND FREE CATALOGUE	TEN STYLES CABLED ELASTIC ALL WIRE	EUREKA FENCE CO. RICHMOND, IND. P.O. BOX 5
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FARM FENCING
MADE WITH EITHER
OUR LARGE OR SMALL MACHINE
WIRE AT FACTORY PRICES

GASOLINE ENGINES FOR PUMPING.

WE illustrate here a cut of the works of the Webster Manufacturing Company, 1075-1097 West Fifteenth Street, Chicago. This company is one of the old manufacturing companies of Chicago, having been organized twenty years ago. They manufacture a special line of machinery for use in cotton seed oil mills, grain elevators, sugar and starch works. They make a specialty of transmission of power by rope friction clutches, but one of their largest specialties is gas engines. Of these they have sent out nearly a thousand.

We advertise in this issue of THE IRRIGATION AGE a small engine which they make especially for pumping purposes. We believe it will fill a much needed want, as it has a large capacity and is very reasonable in price. The engine is a good 2 to 2½ H. P., and is able to pump 3,000 gallons of water per hour, lifting it 40 feet and putting it up to a height of 60 feet.

The motto of this company is "Quality first and always," and they have carried it out in building this engine. While it is offered at a low price which will be attractive to users, yet the engine is made up first-class in every particular.

It gives us pleasure to introduce to our patrons the advertisement of the Webster Manufacturing Company, as we can speak from a personal knowledge of this company. They are one of the strongest and most reliable concerns in their line in the United States.

A full description of these engines will be sent free on application, provided you mention THE AGE.

ALL ABOUT WESTERN FARM LANDS.

The "Corn Belt" is the name of an illustrated monthly newspaper published by the Chicago, Burlington & Quincy R. R. It aims to give information in an interesting way about the farm lands of the West. Send 25c in postage stamps to the Corn Belt, 209 Adams St., Chicago, and the paper will be sent to your address for one year.

PENSIONS were granted Kansas people as follows: Erastus E. Reams, Leavenworth; Burgess Mason, Kansas City; William Hartranft, Canton; James W. Cashner, Argentine.

MAGAZINES.

The contents of the leading magazines are as follows:

Century Magazine.—New York. March.
A Personally Conducted Arrest in Constantinople. F. Hopkinson Smith.
Life of Napoleon Bonaparte.—XVII. William M. Sloane.
Stamping Out of the London Slums. Edward Marshall.
On the Track of the "Arkansas Traveler." H. C. Mercer.
John Randolph of Roanoke. Powhatan Bouldin.
The Elder Dumas. Emily Crawford.
The Perils of Small Talk. Allan McL. Hamilton.
Ways and Means in Arid America. William E. Smythe.
On an Author's Choice of Company. Woodrow Wilson.
Our Foreign Trade. Fenton T. Newbery.

The Cosmopolitan.—Irvington, N. Y. March
Empire-Building in South Africa. Albert Shaw.
The Mystery of Grant. Adam Badeau.
True Story of the Death of Sitting Bull. E. G. Focht.
Old English Silver. S. Leverett Johnson.
Upland Pastures. Ninetta Eames.
The Art of Making Up. Madame Sara Bernhardt.

Scribner's Magazine.—New York. March.
History of the Last Quarter Century in the United States.—XII. E. B. Andrews.
Carnations. J. H. Connelly.
Florentine Villas. Lee Bacon.
Miss Mary Cassatt. William Walton.
French Binders of Today. S. T. Prideaux.
British Opinion of America. Richard Whiting.

McClure's Magazine.—New York. March.
Abraham Lincoln. Ida M. Tarbell.
A Century of Painting. Will H. Low.
Personal Reminiscences of Col. E. E. Ellsworth. John Hay.
Chapters from a Life. Elizabeth Stuart Phelps.
Scientific Kite-Flying. Cleveland Moffett.

Quinton's Magazine.—New York. February.
English View of the Monroe Doctrine.
Is the Duty Added to the Price?
Sherman and Cleveland on Finance.
Chartism: Its Character and Influence. M. McG. Dana.
Tariff Reductions and Fiat Money. E. E. Dodge.
The American Federation of Labor. M. McG. Dana.
Compulsory Arbitration. Jerome Dowd.
Principles of Party Organization. Frank L. McVey.

The Forum.—New York. March.
Family Life in America. Th. Bentzon.
The Nicaragua Canal an Impracticable Scheme. Joseph Nimmo, Jr.
The Army as a Career. Oliver O. Howard.
The Best Thing College Does for a Man. Charles F. Thwing.
Some Municipal Problems. E. W. Bemis.
The Manitoba School Question. Goldwin Smith.
Cost of an Anglo-American War. Edward Atkinson.
An Alliance with England the Basis of a Rational Foreign Policy. Professor Sidney Sherwood.
The European Situation. F. H. Geffcken.
Spirit of Racing in America. Jno. Gilmer Speed.
Manners and Customs of the Boers. T. Lorraine White.

WELL DRILLS

Awarded Highest Medal at the World's Fair.
All latest improvements. Catalogue free.

F. C. AUSTIN MFG. CO., CHICAGO, ILL.

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WELL MACHINE & TOOL CO.

CATALOGUE FREE.

WATER WHEELS

NEW AND SECOND HAND.

Send Stamp for Paper and Catalogue.

Dubuque Turbine and Roller Mill Co.

DUBUQUE, IOWA.

DRAIN TILE

W. S. DICKEY CLAY MFG. CO.,
20th and Main Sts., Kansas City, Mo.

IRRIGATION.

STOP THAT SLIPPING

and save fuel and power by using
Green Seal Belt Dressing. Guaranteed to keep any belt from slipping the moment it is applied. Write us and we will send you a package subject to your approval.

The Phoenix Oil Co.
CLEVELAND, O.
Agents Wanted.

NO WINTER

"Land of Flowers," will be given an excellent opportunity by one who wishes to secure a good neighbor and would divide his property on very easy terms. Eighty acres in Putnam County and twenty acres in Lake County. Write for particulars to Box 189, Chicago Lawn, Chicago.

ENS!

reary grown, varieties 22, prices \$2.50 to 100 Scotch 0 to 12 inches and sizes sent. Send me FREE.

D. HILL, Evergreen Specialist, DUNDEE, ILLINOIS.

AGENTS WANTED.

Mineralized Rubber Hose, Belting, etc., is better and cheaper than Vulcanized. Free samples to live salesmen.

MINERALIZED RUBBER CO., New York.

Fine Opportunity for the Right Party.

Correspondence solicited from experienced Mill-men with about \$10,000 capital, with the view of establishing a flouring mill in one of the finest irrigated sections of the United States, Extra inducements to the right party. Address, stating references, James P. Masie, 417 Chicago Stock Exch. Bldg., Chicago.

VICK'S SEEDS FREE

To introduce our 50c. monthly magazine we will give, absolutely free, 25c. worth of Vick's famous seeds to every one sending us 25c. for a yearly trial subscription within 30 days; 15c. worth of seeds and magazine six months for only 15c.; \$1.00 worth of seeds and magazine two years for 15c. We send **FREE** Vick's Floral Guide (Price 10c.) to select seeds from. We cannot send this valuable book to parties who do not remit.

This offer holds good for thirty days only.

FIRE-IDE PUB. CO., Rochester, N. Y.



DR. OWEN'S ELECTRIC BELTS CURE

WHERE MEDICINES FAIL,

All Nervous Diseases in Man or Woman from any cause Rheumatism and chronic ills.

Write for Catalogue and Free Consultation.

DR. A. OWEN 201 STATE STREET CHICAGO.

IRRIGATE YOUR LAND

USE THE LINK BELT WATER ELEVATOR.

Cheapest machine on the market. Capacities from 500 to 6,000 gallons per minute. Hundreds now in successful operation. Send for circular and price list. Agents wanted.

LINK BELT MACHINERY CO.,

Chicago, Ill., U. S. A.



"THE BOSS" TREE PROTECTOR.

Protect your growing trees from

Rabbits, Squirrels, Gophers, Frost, Sunburn, Grasshoppers High Winds.

Made of Yucca Palm; Strong, Durable, Cheap and Guaranteed to give Perfect Satisfaction. We make all Sizes. Send for Sample Free.

PRICES.

18 in. long, \$12.50 per thousand
24 in. long, 15.00 per thousand
30 in. long, 17.50 per thousand

Agents Wanted Everywhere

YUCCA MFG. CO.

Third St., near Santa Fe R. R.

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HUMPHREYS' VETERINARY SPECIFICS

For Horses, Cattle, Sheep, Dogs, Hogs, AND POULTRY.

500 Page Book on Treatment of Animals and Chart Sent Free.

CURES: Fevers, Congestions, Inflammation
A.A.—Spinal Meningitis, Milk Fever.
B.B.—Strains, Lameness, Rheumatism.
C.C.—Distemper, Nasal Discharges.
D.D.—Bots or Grubs, Worms.
E.E.—Coughs, Heaves, Pneumonia.
F.F.—Colic or Gripes, Bellyaches.
G.G.—Miscarriage, Hemorrhages.
H.H.—Urinary and Kidney Diseases.
I.I.—Eruptive Diseases, Mange.
J.J.—Diseases of Digestion, Paralysis.
Single Bottle (over 50 doses), .50
Stable Case, with Specifier, Manual, Veterinary Cure Oil and Medicated Jar Veterinary Cure Oil, \$7.00
Sold by Druggists or sent prepaid anywhere and in any quantity on receipt of price.
HUMPHREYS' MED. CO., 111 & 113 William St., New York.

\$100,000. Worth New Crop Seeds.

Tons and Tons of Onion, Beet, Cabbage, Cucumber, Melon, Lettuce, Radish, Squash, Tomato, Turnip Seed, etc., and thousands of bushels of Beans, Corn, Peas, Seed Potatoes, etc., and any quantity of Flower Seeds, Bulbs and Plants are offered at astonishing low prices. Every person intending to purchase \$5.00 worth of Seeds, Bulbs, Plants, Potatoes, etc., should send for my "Planter's Wholesale Catalogue" filled with all the best, and prices are from 30 to 50 per cent. cheaper than any other Seedsmen will make you. By ordering \$5.00 worth or more, is why I can supply you at wholesale. Two or three neighbors can club together and make the order \$5.00 and get these prices. Do not buy until you see this Great List. It's free to all. Nothing published like it. Write for a copy to-day.

F. B. MILLS, Seed Grower, ROSE HILL, N. Y.

MENTION THE AGE.

Spiral Riveted Water Pipe

8 TO 24 INCHES IN DIAMETER. 2 TO 25 FEET LENGTHS.

...FOR...

Irrigation, Hydraulic Mining, Water Works, Stock Ranches, Etc.

Connections and Fittings to Suit Service Required.

ABENDROTH & ROOT M'F'G CO.,
28 CLIFF ST., NEW YORK.

VICTOR TURBINE WATER WHEEL.

UPRIGHT OR HORIZONTAL.

The attention of *Irrigation Companies* is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its *remarkably steady motion, high speed and great efficiency* and *large capacity*, for its diameter, being *double the power* of most wheels of same diameter. It is used by a number of the leading *Irrigation Companies* with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent. of useful effect *guaranteed*.

**THE SMITH-VAILE POWER AND STEAM ELECTRICAL DRIVEN
PUMPING MACHINERY.**

SEND FOR CATALOGUE AND PARTICULARS.

THE STILWELL-BIERCE & SMITH-VAILE CO., DAYTON, O.

Rife's Automatic Hydraulic Engine

WATER SUPPLY FOR SMALL TOWNS; WATER-WORKS; RAIL-ROAD TANKS; IRRIGATION; COUNTRY RESIDENCES; ETC.

An entirely new application of the Hydraulic Ram principles. **Large Air-Cushion**, positively air-fed at each stroke, insuring ample air cushion. **Constant Action! Never Stops!** The **Double Acting Engines** pump potable water by impure water without pollution or use of diaphragm. Efficiency very high. Will elevate water 25 feet for each foot of fall! Capacity up to 150,000 gallons daily. Flattering Award at **Columbian Exposition**.

Send your conditions of Spring, Stream or Flowing Well for **guaranteed estimate**. Catalogue free if you mention **The Age**.

A Rife Ram at work Irrigating, etc

TABLE OF SIZES AND PRICES.

Engine	No.	Size of Drive Pipe	Size of Delivery Pipe	Gals per Min Re-juiced Under 5 to 7 Feet Fall	May be Regulated to Use Per Minute	Least Feet of Fall Recommended	Weight	Price, Single-Acting	Price, Double-Acting
	10	1	$\frac{3}{4}$	4 to 5	$2\frac{1}{2}$ to 3	5	125	\$50 00	\$65 00
	15	$1\frac{1}{8}$	$\frac{3}{4}$	6 " 12	5	3	150	55 00	70 00
	20	2	1	8 " 16	7	2	200	60 00	75 00
	25	$2\frac{1}{8}$	1	10 " 24	11	2	225	66 00	81 00
	30	3	$1\frac{1}{4}$	18 " 35	15	2	250	75 00	90 00
	40	4	2	35 " 75	30	2	550	120 00	140 00
	80	8 or 10	4 or 5	150 " 350	150	3	3000	450 00	500 00

Western Agents
PELTON WATER WHEEL CO
SAN FRANCISCO, CAL

RIFE ENGINE CO., 126 LIBERTY ST., NEW YORK

THE IRRIGATION AGE.

VOL. IX.

CHICAGO, APRIL, 1896.

NO. 4.

THE ART OF IRRIGATION.*

CHAPTER XI. IRRIGATING WITH FURROWS (Continued). UNDERGROUND WATER. FLOODING.

BY T. S. VAN DYKE.

ALL systems of making water soak sideways from ditches are practically the same, no matter by what name called or how many distinctions may be multiplied from different ways of running the water. Filling up the soil with water from below by seepage from large ditches around the tract differs somewhat from this, but hardly enough to justify calling it a new system. Sometimes it is done unintentionally and on a very large scale, as in parts of the great San Joaquin valley in California, where the steady seepage for several years from large ditches and waste water has raised the level of underground water, over tens of thousands of acres, from sixty or seventy feet to six or seven or less. Sometimes it is unintentionally done on a small scale by the use of too much water on land having hardpan, clay or other impervious material beneath. On all land not well drained it is liable to happen from very ordinary waste after the land has been irrigated several years. And sometimes it is done intentionally where the conditions will allow it. And where the soil is very "leachy" (lets water through too fast) it may be advisable to do it as the cheapest method, and in some rare cases the only method. Its simplicity commends it in many cases where other methods are far better, and it is the favorite of many a lazy man who has plenty of water, because there is nothing to do but let it run. Sometimes the ditches are made around the tract, sometimes across it, sometimes both; often they

are large and often small, but it is all the same, and is generally possible only on land that is quite sandy.

At first glance it seems fine to dispense with work and cultivation in this way, and have the roots go down out of the way of evaporation. Being a kind of subirrigation, it has all the attractions of that system with apparently none of the disadvantages of underground pipes.

Time, however, shows that many things are injured by having the roots in standing water, while some are killed. It is doubtful if anything does as well that way as under surface irrigation on land well drained. It certainly does not if the water becomes stagnant and heavily impregnated with salts of iron, making it "sour," as it is often called. And if the water is clear and changing, with a steady underground flow, it is doubtful if anything does as well in it. While alfalfa will grow on such ground, and often give large yields, it has been proved over and over again that alfalfa, on well drained open soil with surface irrigation, is still better. The same is true of the pear, which will often do well on ground too wet for other deciduous trees, but with plenty of water does still better on well drained benches. With the orange and lemon, and most of the deciduous fruits, there is no longer room for question. Grapes of some kinds will bear heavily on wet land, but you can see the difference on higher soil, while the finest corn I ever saw was

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on land twenty feet from water and heavily irrigated with warm water on the top. Eight acres averaged 115 bushels to the acre, and most of it was over fourteen feet high. I have seen very fine corn in the same region and on the same kind of soil, low along the river where the water was but a foot from the top, but it would not run over ninety bushels. On the whole, it is pretty safe to say, do not irrigate in this way for anything unless there is some special economy in it, and then plant only such things as you are sure will stand it.

Where the head of water is great and the feeding flume large enough, furrow irrigation may become practical flooding, as in the picture given in Chapter X of bad furrow irrigation. If you had 180 streams of one miner's inch each, and should run them for twenty-four hours on ten acres, this would be one half of 360 twenty-four-hour inches, or about half the whole allowance for the year under many of the best water rights in Southern California. This would equal about nine inches in depth, or three-quarters of an acre foot. Nothing but very coarse sand could take such an amount of water as that, even if distributed over the twenty-four hours evenly in steady fine rain. The folly of trying to put it on from a ditch must be apparent. Yet that was about what the irrigator was trying to do in the picture of bad furrow work. It leaches out fertilizers, cuts the soil and is in every way bad. When the soil is so coarse as to require such large streams you are approaching the point where it is best to flood. Nothing but sandy or gravelly land will need streams of an inch apiece, and nothing but land nearly level will stand them. You have, therefore, the conditions for flooding, and had better do it directly than indirectly. You can then save your fertilizers, avoid cutting and do better work.

Where you can get a large head of water for only a short run you are generally compelled to flood no matter how well small streams might run upon the soil. This is liable to be the case at times on many ditches depending on the flow of a stream and not supplemented by reservoirs. If the amount of water used is based on the average of the summer flow, as it should be instead of on the minimum, on which no one can figure and which should not be established as the limit of the capabilities of any country,

there will be times when a run of large heads for a very short time may be the only way of accommodating all consumers. This is liable to happen at the driest and hottest part of the season when vegetation is demanding the most water to evaporate and will suffer the most if it does not have it. And sometimes it wants it furnished very quickly, too. In such case you may have to take a hundred inches of water for five acres and handle it all in two hours or so. And you may have to be on hand at three o'clock in the morning to take your turn, and every minute you lose is so much gone, for at the precise minute it is cut off. Such occasions are short, but you should figure on them as possibilities. You should find out such matters before buying or planting, and especially before deciding what system to adopt. Sometimes it is easy to change from flooding to furrows and vice versa. But sometimes it is not. It will depend very much on how you have prepared the ground.

PREPARATION FOR FLOODING.

If land is to be flooded even more care should be taken in preparing it than if it is to be watered from furrows. The depth of water in all the checks should be as nearly the same as is consistent with reasonable economy in grading. And it will not do to economize too much in this. In many cases it would ultimately pay to terrace the land somewhat in very broad steps, taking care to leave no jump-off places, but smoothing it down so that machines can run over it. If the checks are not level then the water stands deeper in one place than in another. For best results the water should be rushed over the land in as thin sheets as possible, and never allowed to stand longer than requisite for enough soaking. Otherwise uneven wetting results and the lower part is puddled too much, both bad whether cultivation is to follow watering or whether the piece is in something permanent, like alfalfa.

If your land has a slope of twenty-five feet to the mile, which looks almost level on a large plain, checks one hundred feet wide would have the water in the lower side about six inches deeper than on the upper side. If you increase the depth so as to give enough to the upper side you injure the lower, for the six inches it already has are too much for almost any

crop or orchard. If you reduce the size of the checks to twenty feet you still have over an inch difference. This is all right for orchard work, but checks as small as that are generally a nuisance for alfalfa or most field crops. To bring the larger check right would require only a few inches shaved off the bottom of the upper side and spread over the lower. To do this well is not very expensive and would in most cases be repaid by the better crops and greater ease of handling the run of water. This is best done by large scrapers that carry dirt easily in large quantities, like the Fresno scraper. The man who attempts to economize at this stage of irrigation is very foolish and will ever regret it. Preparation of the ground is two-thirds of the battle, and this is the last case in which to underestimate the enemy. To repair the mistake afterward is generally difficult and in case of orchards nearly impossible.

It will also pay to have the flow from the feeding ditch regulated by something better than dirt and the water had better be diverted by something better than a dam of earth or a piece of cloth on two skewers or a bit of board stuck in the ground. Even a sheet iron dam is not the best. It costs little to fix all these things well at the outset and a good gate of lumber with a cut-off from the main takes very little material and can be made at home.

The shape of the checks into which the field is to be cut to hold the water is of no consequence. If permanent they are best made according to the contour of the land; if temporary, square. Where the ground will permit it is common to make them square, but they are made in all sorts of shapes according to the lay of the land, the nature of the crop and the whim of the irrigator. If they cannot well be made rectangular for orchards it is pretty good proof that the land has not been well prepared and you had better stop right there and go back and prepare it. When so prepared it is more easy for temporary work to make them in squares or "oblong squares," as rectangles are called, than any other form.

The size of the checks will depend upon the slope of the land, the head of water at your disposal, and the nature of the crop.

The more nearly level the land the

larger you may make them. But you must first be sure that the head of water is large enough to fill them quite rapidly and discharge from the upper ones to the lower ones quite rapidly. Otherwise you will have slow and uneven flooding, which should always be avoided. If you should try to flood forty-acre checks with a fifty-inch head of water—a cubic foot a second—you would find yourself in trouble if you had many to fill.

The speed with which the water will flow through the checks and pass to the next ones will depend also on what is in them. If there is a stand of alfalfa or grain in them the stalks will retard the flow. You must therefore have a larger head of water. If you have plenty of water, in heads large enough, it is generally best for all field crops to make the checks as large as the slope of the ground will permit. Especially is this the case if they are to be left there permanently and be run over with mowing machines. But care must be taken not to have the ridge too high on the lower side. This may, however, be partially obviated by making them very broad at the base, and this should always be done where they are to be left and run over by machines instead of being broken up every time by cultivation. In all cases they should be so strong that there is little danger of their breaking. For if one goes the extra rush of water may take the next one, and in careless work one may see a whole line of temporary checks go one after the other as certainly as a row of bricks.

LARGE AND SMALL CHECKS IN MEXICO.

The largest checks I have seen were near Lerdo in the state of Durango in Mexico. While I have to depend on memory I am certain that I have there seen fields of corn and cotton half a mile square, irrigated in one check almost perfectly level, and one cornfield in which I hunted ducks several times was fully a mile square. The water stood all over it at nearly uniform depth and the irrigating head that I saw turned into it was fully five thousand inches or one hundred cubic feet a second. This work was well done and the crops were very fine. I cannot see that smaller checks would have been any better. And while a larger yield to the acre could have been had by better

plowing and cultivation, it is not easy to say that the difference would have paid.

There is little land anywhere that will justify such large checks. This was the most level land I have ever seen, and was probably once the bed of a lake fed by the River Nazas. The water was practically of uniform depth throughout and took over two days to spread thoroughly over it. There were dry places all through it, but so very low and small that they amounted to nothing. They came, no doubt, from uneven plowing, but the water soaked through them fast enough.

On the other hand, the smallest checks I have ever seen used for field crops were in Mexico on a large hacienda near Jimenez. Several thousand acres were planted in wheat, and the whole was in checks about ten feet square. I was over it several times in January and the stand of wheat was very good and it no doubt made a fair crop. The land was black adobe. The checks were made with the common wooden plow of the country a bit of log six or eight inches in diameter sharpened at the end. They had in places been patched up with a hoe, but the whole work was quite well done. It could pay only with very cheap labor like the peon labor of Mexico. The checks were undoubtedly so small on account of the slope, which did not appear great on account of big mountains in front, but which must have been considerable to require so much labor.

METHODS OF THE CHINESE.

For lettuce, radishes and other vegetables to be grown very early, the Chinese market gardeners often use checks even smaller than ten feet, and even on level ground. They seem unable to tell the reason, but it no doubt is because they can in that way run a thin sheet of water over the whole, get it in the ground more evenly and in less time per square foot than could be done with larger checks. In this way there is no such chilling of the

ground or puddling in places as if more water were turned into larger checks. By taking care in this way they raise good vegetables in fair quantity without any cultivation, even very tender ones suffering little if any.

But when it comes to later crops and things to be grown on a larger scale, the Chinaman finds this small checking too slow. He then makes them of many sizes and shapes. For tough stuff like cabbage he will sometimes make them half or even the whole length of the field, and from twenty to a hundred feet wide. He prefers furrows for almost everything where they can be used, but when they will not work to advantage he does not hesitate to flood. But he tries always to rush the thinnest sheet over the ground in the shortest time, unless the nature of the crop makes it unprofitable to spend too much work on it. He is a good irrigator and no one can afford to ignore his work. It is worth studying for the principles involved, and cheap as his labor is, he is still a close figurer in economizing work.

For alfalfa and other field crops where the land is flat enough and the head of water large enough, forty acres make about as large a check as is generally consistent with economy. In the San Joaquin valley of California, probably the greatest alfalfa region in the world, many are larger than that. Many are also smaller, and it is difficult to see any advantage for ordinary farms in having them over ten acres for anything. While it is well to imitate the methods of prosperous settlements, you must still remember that the secret of success in flooding is to get the water in the ground as rapidly as possible and in as even sheets as possible, avoiding all puddling and scalding, which will result if the water is allowed to stand anywhere too long. Other things being equal the smaller the checks the more easy it will be to do this.

(To be Continued.)

WATER SUPPLIES FOR IRRIGATION.

CHAPTER IV. THE DEVELOPMENT OF UNDERFLOWS.

BY F. C. FINKLE, C. E.

THE term underflow is often applied to any water below the surface of the ground. In this way it is sometimes employed to designate both artesian and ordinary sub-soil water. Such an application of the term is decidedly improper and should be discouraged as far as possible. As the term itself expresses, it means water which is both under the surface and flowing. It can, therefore, neither mean ordinary sub-soil water, which is standing water merely filling the voids in the sub-soil, nor artesian water, which is confined under pressure in underground reservoirs and channels, and flows only when the impervious layer confining it is perforated by artificial means.

Since underflow water does not exist on the surface it cannot be taken by simple diversion in the same manner as the surface flow of streams. When its utilization is contemplated for irrigation purposes the first step to be taken after its existence has been determined is to bring it to the surface. This is termed developing it. Before the mode of development is fixed upon there are several things which should be carefully determined. The most important of these are:

- (1) Point where the water is to be, or can be used for irrigation.
- (2) Points where development is practicable.
- (3) The probable volume of underflow.

If no tract of land requiring irrigation is found to exist sufficiently near and below the bed of a stream possessing an underflow its development for irrigation purposes will of course be a useless undertaking. While it is a rare occurrence, indeed, to find such a case in any arid region of the earth, yet it may occur and sometimes does.

Rivers of slight inclination and high banks are often encountered, and in such cases territory which can be irrigated from them is difficult to reach by means of a gravity system. In doubtful cases

the only way to determine such questions as the existence or extent of a body of land which can be irrigated from the underflow of a stream, and the cost of conveying the water, is by making surveys. Frequently no surveys are necessary for determining the point where the water can be used, as irrigable land exists in abundance and the fall of the stream and surrounding country is much greater than necessary.

After a tract of land susceptible of being benefited by the water in a degree which will insure the undertaking to be profitable has been located, a suitable place for the development of the underflow must be sought. Such a place must, of course, be selected at an elevation sufficiently higher than the land to be served to render the conducting of the water to it possible by gravity flow.

The point for developing an underflow should be as low down on a stream as it is possible to find one, in order to derive benefit from as large an area of watershed as practicable. The narrower the canyon of the stream, the more easy it will be to develop the underflow by any of the methods which can be employed. A dam, tunnel or cut will be more cheaply constructed across a narrow canyon than across a wide one. A place where the depth from the surface down to bed rock or to the impermeable stratum underlying the underflow is shallow is always a desirable point for making the development. Shallowness to the bottom of the underflow is even of more importance than a narrow channel.

But both are of much importance and should be combined in as large a degree as possible in seeking a favorable place for the development of an underflow.

If the proposed development is to be made by a cut, tunnel or submerged masonry dam, a point on the stream where the grade is rapid should be selected. This is important as a factor in reducing the cost of the proposed works to a minimum.

In streams of rapid descent a shorter cut or tunnel will suffice to reach the same depth, and in draining the foundations for a submerged dam less pumping will be required, as short drain cuts or tunnels can be employed.

PROBABLE VOLUME OF UNDERFLOW.

We have already seen how the existence of an underflow can be determined by the natural characteristics of the watershed and channel of a stream. By the same means the volume of the underflow can also be judged. That is to say it can be determined whether it is probable that the underflow is quite considerable, or whether it is small and unimportant. It is impossible, however, to determine the exact amount of the underflow from any observations in regard to the channel and watershed of a stream. In fact it can be seen very readily that it is a difficult matter to ascertain the volume of a stream of water flowing by underground percolation through sand and gravel. Some experiments covering the velocity of water percolating through such materials as usually comprise the beds of rivers have been made by engineers. From these experiments the following laws have been deduced: The velocity of percolating water varies directly as the density and character of the stratum through which it percolates, and as the square root of the one-hundredth part of the product of the slope and depth of the percolating stratum. The quantity of water percolating through any formation depends upon the mean velocity of percolation and the area of cross-section of the stratum of percolating water.

By plotting the results of such experiments as have been made with varying grades, depths and classes of material they have all been found to follow quite closely the following formulæ:

$$v = 0.1m \sqrt{\frac{ds}{100}} \text{ and}$$

$Q = a (0.1m \sqrt{\frac{ds}{100}})$, in which the letters denote the following factors:

v = the mean velocity of the percolating water in feet per second.

Q = the number of cubic feet of percolating water per second.

a = area of cross-section occupied by water in the deposit containing the percolating water, in square feet.

d = mean depth in feet of the deposit containing the percolating water.

s = mean fall or inclination per foot of the deposit containing the percolating water, in feet.

m = a variable factor.

The value of the factor m depends on the density of the deposit of materials through which the underflow percolates. A deposit in which a large portion of the mass consists of voids affords an easy outlet to percolating water, while one with less voids makes percolation more slow and difficult.

The following values for the factor m have been deduced from such experiments as have been made and recorded:

For coarse boulders of nearly uniform size, $m = 1.0$.

For coarse boulders with some gravel, $m = 0.9$.

For boulders with considerable gravel, $m = 0.8$.

For coarse gravel, $m = 0.7$.

For coarse gravel with some sand, $m = 0.6$.

For coarse river sand with some gravel, $m = 0.5$.

For ordinary sharp river sand with very little gravel, $m = 0.4$.

For coarse quicksand, $m = 0.3$.

For medium quicksand, $m = 0.2$.

For fine quicksand, $m = 0.1$.

For intermediate cases between those enumerated above the values of m can be approximated from those given.

While it is not believed that the formulæ given above will produce results which are entirely exact, yet, if the true conditions are arrived at, employing the formulæ will give as close results as are required for all practical purposes. The best method for determining the depth and area of cross-section of an underflow is by making borings at intervals across the stream from the top to the bottom of the water-bearing formation. If the expense of making such borings cannot be incurred, the only way to determine these things is by approximation from such characteristics of the stream as are observable. The slope of the river bed, the proximity of bed rock at the sides of the channel, the dip or angle of the materials comprising the sides of the river bed, the width of the channel, the distance from the surface flow to the top of the underflow and other things of a like nature are often guides, which help to determine the probable depth and sectional area of the underflow.

Sometimes the underflow of a stream does not occur in the usual form of a continuous sheet of water gradually percolating through the sand and gravel of a river bed. There are instances where the formation is partially cemented and obstructs the free percolation of the underflow water. In cases of this kind the passage of the water is obstructed by the solidity of the formation and it breaks through in small streams, which are separated from each other by intervening dry formations.

It sometimes occurs in instances of the latter class that the formation in the channel of the stream is so much more compact than that adjacent to the stream that the underflow is either partially or wholly deflected laterally and flows in a different direction from the stream itself. This, of course, does not occur in narrow, rocky canyons, but on streams with low banks of permeable material. On account of cases of this nature we often find that streams with a very large and good watershed possess little or no underflow. The absence of underflow in streams, however, is generally due to other causes. These are the opposite of the characteristics of a watershed and stream channel, which have been previously outlined as essential to the creation of an underflow, and their discussion in detail is therefore deemed unnecessary.

ESTIMATING AND DEVELOPING IRREGULAR UNDERFLOWS.

Such underflows as have been discussed in the preceding paragraphs may be said to be irregular both from the fact of their being exceptional and on account of their departure from established rules. Consequently their volume cannot be estimated in the ordinary way, nor can they be developed like regular underflows. Estimates as to the quantity of an irregular underflow must rest largely on the skill and judgment of the engineer who makes the investigations. Sometimes there are circumstances which can make the results nearly certain, even in irregular cases, but usually the conclusions arrived at are merely rough approximations.

The most satisfactory method of developing an irregular underflow is by means of a system of tunnels and shafts crossing the stream at nearly right angles. The shafts are necessary in order to make the running of drifts on different levels possi-

ble so as to follow the levels where streams occur in the formation. The first work should always be the sinking of shafts, after which the tunnels can be commenced back on a level to reach the required elevations.

MODES OF UNDERFLOW DEVELOPMENT.

The different methods of developing underflows are as follows:

(1.) By cuts. (2) By tunnels. (3) By submerged dams.

The conditions and circumstances surrounding each case must determine which of the above methods is to be employed in making the development. Without entering into a discussion of the principles governing the designing and construction of these structures, which matters will be discussed in succeeding chapters, we will now briefly discuss the rules governing the application of the different methods of development already enumerated.

THE DEVELOPMENT OF UNDERFLOWS BY MEANS OF OPEN CUTS.

Cases are rare where open cuts can be employed wholly as a means for developing the underflow waters of a stream. The objection to this mode of development in the ordinary run of cases encountered in practice is, that most streams are subject to heavy floods and overflow at certain times of the year. As the development usually has to be made in the bed of a stream, such floods or overflows would cause open cuts to be filled up and obliterated, so that the work would have to be done over periodically. The following instances often occur, however, in which this objection does not apply: (a) when the outlet of the underflow drain can be located outside of the overflow channel and the drain under it in such a manner that it can be covered over after being supplied with a flume or pipe; (b) when the stream is not subject to greater floods than can be controlled by aprons or bridges across the cut.

When either of the above conditions obtains cuts can be considered as a method of development, provided always that the underflow at the proposed point is not too deep to be reached by means of a cut. Economy and practicability prescribe that a cut for the purpose stated should not exceed a certain depth. Both the cost of construction and the cost of future

maintenance must be considered in determining whether a cut should be made or some other method employed. The materials encountered in river beds are commonly of a loose character and will not stand on abrupt slopes.

It is therefore necessary to make the slope of the sides flat, which increases the quantity of earth to be moved very rapidly as the depth of the cut increases.

When the limit in depth has been reached at which a tunnel can be constructed and maintained equally as cheaply as a cut the former is to be preferred, even if a cut will be equally as safe.

DEVELOPMENT BY MEANS OF TUNNELS.

Tunneling is undoubtedly the most customary method of making underflow developments. It is always safe provided the proper location is made and the proper method of construction is employed. The mouth of the tunnel should invariably be located at one side of the channel of the stream and above the high water or flood mark. The mouth of the tunnel should also be located far enough down or away from the channel so that sufficient grade will be obtained to preserve a depth when the tunnel penetrates under the channel, which will place its depth at a point safely below the erosions liable to occur from the heaviest floods. At times an open cut and a tunnel can be combined more advantageously than the use of either one singly. When for a long distance outside of the regular channel and above the flood line the tunnel would run at a shallow depth below the surface, a cut can be made, thereby causing a considerable saving,

until a depth is reached at which a tunnel would be more economical.

SUBMERGED DAMS AS A MEANS OF DEVELOPMENT.

When the underflow is near the surface, and a point where bed rock approaches the sides of the canyon and is found at a shallow depth can be located, a submerged dam is possibly the cheapest method of development. This will prove to be true more particularly when the grade of the channel is light, so that a very long tunnel would be required. Before a submerged dam is undertaken it must be known with certainty that the bed rock is continuous and unbroken, so that no water will escape under the dam after it is completed. The object of a submerged dam is to raise the underflow to the surface, and leaks in the foundation, which will grow and undermine the structure or allow the water to escape under the dam, must be avoided.

Submerged dams can sometimes be constructed with some impervious stratum other than bed rock for a foundation. Such cases, however, are quite rare and undertakings of this sort more often result in failure than in success.

Tunnels and submerged dams are often combined in the development of underflows. A tunnel may be used in connection with a submerged dam for the purpose of draining the foundation to facilitate construction, or a dam may be constructed across the channel at some suitable point on the line of the tunnel for the purpose of collecting the underflow into the tunnel, or for holding it back and regulating its flow when only a part of it is required for use or when it is not to be used at all.

(To be Continued.)

OREGON AS A FRUIT GROWING REGION.

By H. T. W.

THE eastern portion of the State of Oregon was, for a long time, regarded as being inferior to the strip of country lying west of the mountains, on account of the lack of rainfall, but since the advantages and possibilities of irrigation and diversified farming have become more generally recognized it has been the scene of active development. Its immense beds of valuable minerals, its rivers and vast cattle ranges made it a country of great wealth, and of late years its agricultural and industrial growth have kept it fully abreast the progress of modern civilization.

In the eastern portion of the State bordering upon the Great Snake river lies Malheur county. Here is a country of hills and valleys, watered by running streams, enjoying the genial and health-giving climate which has been the fame of Southern Idaho. In this county, near the lively town of Ontario, is located the one thousand acre K. S. D. Fruit Farm. This farm has attracted wide attention on account of its magnificent park and beautiful driveways, Grand Boulevard being sixty feet wide and two miles long. The growing orchards, the broad acres of alfalfa and clover, surrounded on all sides by thousands of tall shade trees and flowing streams of clear water, give the place the appearance of an ancient private estate.

This farm consists of about 1,000 acres, of which 360 have been planted in alfalfa, forty acres as a winter apple and pear orchard and ten acres as a prune and garden orchard, the balance being fenced and under ditch but not cultivated. There are 27,000 shade trees and 6,000 fruit trees on the farm which is located within one-half mile of the main line of the Union Pacific Railroad. The water for irrigation is supplied through two canals, one each from the Owyhee and Malheur rivers.

Six years ago the owners, Messrs. Kiesel, Shilling and Danilson, adopted a broad policy of improvement—fencing and cultivating the land, setting out fruit and

shade trees, making roads, erecting barns and outbuildings, and finally taking an active part in the building of the irrigation canal which was to furnish the water so necessary for the growing of crops and orchards. At the present time they are making preparations for the setting out of a large number of fruit trees, making a veritable orchard of the country.

It is only a short time since the fruit industry was started in Eastern Oregon. Formerly the large producing orchards lay west of the Cascade range in the valleys adjacent to the coast cities where the great rainfall assured abundant crops of grain and fruit without irrigation, but they are beginning to see that the countries which the Creator has kept hidden away under a mask of apparent barrenness are in reality His greatest store houses of wealth, and that the irrigated orchards of Eastern Oregon are destined to be the great fruit producers of the State. Scarcely anywhere can the apple, prune and pear be grown so successfully as in the Snake River valley, near Ontario. The soil, climate and everything is especially adapted to fruit culture. This land produces some of the finest apples, prunes and pears in the world, also grows to perfection peaches, cherries, plums, apricots, grapes, nectarines, etc. Indeed, their twenty-four ounce apples are the prize takers wherever they make their appearance, while the peaches (twelve inches in circumference) are looked upon with astonishment.

While the largest profits in this country will ultimately come from the orchards, the first yields will come from alfalfa and vegetables. For feeding horses, bees, sheep and stock hogs it is all that is required. With porous soil, plenty of water and warm seasons, after the first year three crops may be cut, aggregating six to eight tons per acre, besides the pasture thus afforded. It sells in the stack from four to eight dollars per ton. Another industry receiving considerable attention is the cultivation of hops. The

GRAND BOULEVARD, TWO MILES LONG, ON THE K. S. D. FRUIT FARM, NEAR ONTARIO, OREGON.

average yield is about 1,700 pounds to the acre, but with good cultivation this can be increased. The suitable soil, favorable climate and reasonable price for material, labor and transportation will enable growers to do business at a profit.

The average yield per tree of apples and pears is from three to five hundred pounds, and sell at from one to two cents per pound. And this is sometimes greatly exceeded.

Wheat yields from twenty to forty bushels per acre; oats from forty to sixty bushels; potatoes from one hundred and fifty to three hundred bushels. The average retail price of the grain crops is about \$1.25 per hundred.

Messrs. Kiesel, Shilling and Danilson deserve credit for their enterprise in building up new industries in the Eastern Oregon country.

HOW LARGE SHOULD THE IRRIGATED FARM BE?

THE number of acres which the average irrigated farm should comprise must, of course, depend upon a variety of conditions. While there is no doubt that farming operations may be carried on profitably on large areas of irrigated land by single owners, yet it is with the small holding that most men are specially concerned. In fact, the small farm is the key to highest success in a broad sense, when considered as affecting communities, large districts or even States. Local conditions must largely determine the acreage in the irrigated farm. In many cases individual caprice will alone rule in this connection, but in well regulated colonial settlements the matter may be largely controlled by the management of the original subdivisions of the land. Perhaps wisdom would suggest only the outside limit of the amount to be sold to any one purchaser. Subdivision into five-acre lots is often convenient, and the limit of original purchase may be fixed at some multiple of that amount not exceeding, say, forty acres.

The object generally to be attained by compact colonial settlements should be kept steadily in view, and the land so peopled as to render it most valuable, not only to the purchaser but to the colony. For it must be remembered that the entire community gains or loses by every accession to its ranks. Every industrious, honest, thrifty and progressive colonist who is content to make a comfortable home on a ten-acre lot is worth far more to a settlement than the man who indifferently manages the poor cultivation of eighty acres and will not be satisfied with a small holding. If the settlement be mainly devoted

to fruit culture the acreage in the farms may generally be smaller, perhaps, than if the land be devoted to dairying or some other pursuit.

The best possible results to flow from colonial settlements upon irrigated lands within the arid belt will be found to come from the cultivation of the land by the owner and his family, or by them with the aid at harvest time of a little outside help. The limit of the holding, therefore, should generally be fixed by a full consideration of this fact in connection with local conditions of climate, products and markets. In districts where orcharding is a recognized specialty it has often been found that ten acres, intensively cultivated and intelligently managed, have proved entirely adequate to the support of a family, and also to give a tidy surplus at the end of the year. But good crops and good prices are not always certainties, even in the irrigated regions, and perhaps a greater diversity of production should be undertaken in most places within the new regions developing upon the arid domain.

A ten-acre orange or lemon grove, in good bearing, should ordinarily give satisfactory results to almost any modest family, but insect pests, frosts and other calamities sometimes cut short the profits, and thus bring discomfort if not great inconvenience to the orchardist. Ordinarily, and in most settlements, it will be found better to undertake a somewhat diversified husbandry, even on the small holdings appropriate to such localities. The more self-supporting a family can be the better. To be brief, everything should be produced that can be produced with less cost or

greater convenience and profit than outside purchases of such commodities would entail. The butter, eggs, meat, fruit, vegetables, milk, honey, jellies, sauces, oil, wine, etc., required by a family should, if possible, be produced on the home acres, though reserving enough space to produce the surplus crop deemed most valuable for the locality and surrounding conditions.

Every foot of land should be made to yield some profitable crop. The barbarism of waste everywhere seen about the large farm should have no place on the snug little irrigated farm of the colonial settlement. If the season will justify, two or more crops of vegetables should be produced on the same ground each year, and the land should thereby become better for the extra cultivation and fertilizing. Every scrap of fertilizing material should be carefully preserved and applied to the land in due season. Ashes and meat scraps should be utilized in making soap wherewith to wash fruit trees, and leached ashes should never be thrown into the street, but applied to the land. A compost vat should be a prominent feature of the small farm, into which all material available for plant food should go, to be prepared to nourish

the growing crops. In short, the little irrigated farm should be the owner's laboratory, wherein he should transmute the air, the water, the earth and the sunshine into gold.

It will be readily seen that the intensive farmer here contemplated must be not only intelligent but educated and industrious. Backwoods methods will not win on such a farm, and the man who knows too much to learn anything about his business from books and papers should betake himself to the desolate cattle or wheat ranch, for he could not succeed on the small, neat, well-ordered farm of ten or twenty acres. The ablest lawyers are they who know most of the precedents long established, and the physician ignorant of the best work of others in his profession would be justly set aside for a man of the times. It is the same with the farmer. He who depends upon his own knowledge and experience alone is too often trying to do a large business on a very small capital. To read, to study, to experiment, to think and to reason are absolutely essential to success on the small irrigated farm, and he who is above or below this plane would better betake himself to other fields of endeavor.

RECENT DECISIONS UPON THE SUBJECT OF WATER RIGHTS.

BY CLESSON S. KINNEY.

IN a recent case decided by the Court of Appeals of Colorado, the court held that where deeds of water rights provide that, when the grantor (an irrigation company) sells a number of water rights equal to its estimated canal capacity, and two-thirds of those rights are paid for, the title to the canal shall pass to the grantees, and the company received payment for more than two-thirds of all the rights sold, if it sold rights in excess of the capacity of the canal, so that the consumers could not receive the quantities of water purchased, the grantees are entitled to have the title to the canal conveyed to them. And the court further held that the fact that the company's reservoirs might increase the capacity of the canal to furnish water did not excuse the company from executing its contracts in such deeds.

(*La Junta & Lamar Canal Co. v. Hess*, 42 Pac. Rep. 50.)

In another case the same Colorado court held that a deed containing no reference to a ditch which supplies water to the land conveys no interest in the ditch.

(*Child et al v. Whitman et al*, 42 Pac. Rep. 601.)

In the case last above mentioned the appellees offered no evidence of any transfer or deed conveying the interest other than a deed to the land on which the water had been used. The conveyance contained no reference to the ditch, nor were there any apt words of alienation in it. Mr. Justice Bissell in rendering the opinion said: "It is well established that an interest in a ditch is property, which may be transferred or conveyed subject to the same limitations and restrictions which attend a conveyance of real property. A conveyance of land without mention of a water right cannot be taken to transfer an interest in a ditch, although the water carried may have been used upon the land. In this State it is regarded as an independent right, which may be the right of subject of sale and conveyance, but a technical transfer is essential to vest in the transferee a title to the water."

APPROPRIATION OF WATER-FORFEITURE BY NON-USER.

The Supreme Court of California held, in a case decided November 19, 1895, that under the Civil Code of California, § 1411, declaring that an appropriation of water must be for some useful or beneficial purpose, and that when the appropriator ceases to use it for such a purpose the right ceases, not only to the water rights, but also to the rights of way for ditches, given by the Rev. Stat. of the U. S. §§ 2339, 2340, over land which at the time of the appropriation belonged to the public, are lost by non-user for five years, the period for obtaining the prescriptive title, or losing the prescriptive right by non-user.

(*Smith et al v. Hawkins*, 42 Pac. Rep. 453.)

This seems to the writer to be a correct construction of the sections of the statute. But it seems as though the statute was exceedingly liberal upon this subject. In this western country where water is the very life of agricultural development, five years seems to be a long period of time to wait before a water right, which the prior owner has to all intents and purposes abandoned, can be declared forfeited by his non-user of the same.

In the opinion the court said: "In this State five years is the period fixed by law for the ripening of an adverse possession into a prescriptive title. Five years is also the period declared by law after which a prescriptive right depending upon enjoyment is lost for non-user; and, for analogous reasons, we consider it to be a just and proper measure of time for the forfeiture of an appropriator's rights for a failure to use the water for a beneficial purpose. Considering the necessity of water in the industrial affairs of this State, it would be a most mischievous perpetuity which would allow one who has made an appropriation of a stream to retain indefinitely, as against other appropriators, a right to the water therein, while failing to apply the same to some useful or bene-

ficial purpose. Though, during the suspension of his use, other persons might temporarily utilize the water appropriated by him, yet no one could afford to make disposition for the employment of the same involving labor or expense of any considerable moment, when liable to be deprived of the element at the pleasure of the appropriator after the lapse of any period of time however great."

WASTING WATER.

In the case of *Roeder v. Stein*, decided by the Supreme court of Nevada in December, 1895, and reported in the Forty-second Pac. Rep. 867, the court discussed the subject of wasting water by those who had originally appropriated it for some beneficial use or purpose. And the court held that where it appears that the plaintiff made the first appropriation, by means of a certain ditch, of enough water to irrigate 125 acres of land, and that subject thereto the defendant had made an appropriation, the court has the power to direct that the plaintiff must use the water through that ditch or by other means that will be least wasteful. The court further held that the first appropriator is only entitled to the water to the extent that he has use for it when economically and rea-

sonably used. When he has that he cannot prevent others from making use of the surplus; and the court also further held that after others had acquired rights to the use of the water of the stream, the first appropriator for irrigating purposes cannot, to their detriment, change the method by which he conveys it to his land, so as to increase the waste that naturally occurs in such conveyance. The court in the opinion said: "As already remarked, water is too precious to permit its being wasted. Conveying it through a ditch, even, will always cause some loss, and if the distance is great or the soil loose or porous the loss will be considerable. This, within any reasonable expense, is generally unavoidable. But, however this may be, if the appropriation has been made before others acquired rights in the stream, after that no change can be made to their detriment. The first appropriator must continue to use it in at least as economical a manner as before, and cannot change the method of use so as to materially increase the waste. Such a change may be forbidden and parties 'may be compelled to keep their flumes and ditches in good repair so as to prevent any unnecessary waste.'" Citing, *Barrows v. Fox*, 98 Cal. 63; 32 Pac. Rep. 811.

THE DIVERSIFIED FARM

In diversified farming by irrigation lies the salvation of agriculture

HOW TO PREVENT INJURY FROM FROST.

BY F. C. BARKER, NEW MEXICO.

[N studying methods of preventing injury from frost it is necessary to have a clear knowledge of how and why the temperature falls and frost is produced.

The surface of the earth is continually losing heat by radiation into space, but during the day it usually receives heat from the sun more rapidly than it loses it by radiation, and therefore it grows warmer. Radiation, and consequent loss of heat, takes place most rapidly when there is nothing to obscure the sky. Clouds or any other obstruction act as a screen in retarding it. The escaping rays of heat strike the obstruction and are driven back to the earth. This is why frost is more likely to occur on a clear night than when the sky is cloudy. It also explains why smudge fires, by forming a screen of smoke over the orchards, are a protection against frosts.

Cold air is heavier than warm air, and this principle causes the air on slopes, as it becomes chilled by radiation, to flow down into the valleys, where it accumulates and becomes injurious. We thus understand why trees on the foot hills often escape injury from frost, while those in the adjoining valleys are damaged. Smudge fires are only effective on broad, flat expanses of land. In narrow valleys the cold air comes down from the hillsides and gets underneath the smoke. On windy nights the danger from frost is lessened by the warmer air above getting mixed with the colder air below.

The above theories of the radiation of heat and the falling of the colder air are tolerably well recognized by all orchardists, but there is another and perhaps more important law of nature, which is but little understood, and this is the "dew-point" theory.

Every one knows that the atmosphere holds a very considerable amount of water

in the form of vapor, and that this invisible vapor, which is invariably present in greater or less quantities, can always be condensed into water if the temperature of the atmosphere be sufficiently lowered. If the condensation takes place at temperatures above the freezing point of water, the moisture is deposited as dew; if below the freezing point, the condensation is in the form of frost. To fully comprehend what follows, it must be understood that the temperature at which condensation begins is called the dew-point, and this varies with the amount of moisture or vapor in the air. The greater the proportion of moisture the less the fall of temperature required to condense it into dew or frost. When the air is saturated with moisture the dew-point will be reached at a higher temperature than when the air is dry. For instance, in a dry atmosphere the dew-point may not be reached until the thermometer falls to 28 degrees Fahrenheit, when frost forms. At this point peach buds are seriously injured.

If, however, you can artificially add to the amount of vapor in the air by keeping the land moist by means of recent irrigations, then you raise the dew-point and frost may be formed at a higher degree of temperature, or say at over 30 degrees Fahrenheit, which is the amount of cold necessary to injure peach blossoms. If, therefore, you can prevent the temperature of the atmosphere from falling to 30 degrees, you are safe. At first sight it may appear that if the vapor in the air freezes at 30 degrees and the indication of heat still continues, the temperature will continue to fall until injury results. But here a very wonderful natural law comes into play.

Of course it is well understood that an enormous amount of heat has been required to convert water into atmospheric vapor. This heat is latent in the vapor, and when the latter is condensed into frost

or dew this great amount of latent heat is given off into the atmosphere, and tends to keep it at an even temperature. You have two forces at work. Firstly, the radiation or loss of heat is reducing the temperature to the dew-point, while the heat given off by the condensation of the vapor is keeping up the temperature just as fast as it falls to the dew point. The result is that unless the radiation is very great the temperature does not fall. Of course this theory does not work except in cases where slight frosts would otherwise occur. For instance, where in a dry atmosphere the dew point would not be

amount of heat that was expended in forming the vapor, and how enormous this is may be judged by the fact that the condensation of a pint of water from its vapor state will result in enough heat being given off to raise more than five pints of water from the freezing to the boiling point. We thus arrive at the seeming paradox that the formation of frost from vapor produces heat in the atmosphere.

In using smudge fires it should be understood that the heat of the fire has but little effect in diminishing the intensity of the frost, almost the entire protection

WIND MILLS AND RESERVOIR OF E. E. FRIZELL, NEAR LARNED, KANSAS.

80 acres in alfalfa, 25 acres orchard, 10 acres Irish potatoes, 5 acres sweet potatoes, 5 acres onions, 5 acres cabbages, total, 130 acres.

reached before the temperature had fallen to 29, the dew-point may be reached at 31 in a moist atmosphere. In the former case the peach buds would be destroyed, while in the latter case they would escape injury. Hence the object of keeping the surrounding atmosphere moist, and this can be attained by frequent irrigations or even spraying of the orchards at the critical period of blossoming. That this is not a fallacious theory has been proved over and over again by orchardists who have kept their land well saturated with water during the blossoming season, and who have escaped injury from frost while their neighbors who have failed to follow this practice have suffered. The heat given off by the condensation of vapor into dew or frost is exactly equal to the

being gained by the screen of smoke produced. The efficiency of smudge fires may be greatly increased by spraying them with water, thus adding vapor to the atmosphere and raising the dew-point, for as has already been explained the dew-point is reached at a higher temperature when the vapor in the air is increased. Moreover, by spraying the fires, the heat, which would otherwise establish an upward current of warm air that conducts the heat upward and beyond the space needing protection, is utilized in forming vapor and distributed through the lower stratum of air where it is most needed. As soon as this vapor is condensed at the dew point, this latent heat is set free and tends to raise the temperature. Every quart of water thus evapo-

rated and again condensed in the surrounding air is sufficient to raise the temperature ten degrees throughout a space eighty feet square and deep.

FERTILIZING ORANGE ORCHARDS.

BY W. C. FITZSIMMONS.

IN no department of soil tillage does a knowledge of "book farming" pay better than in the production of fruits of various kinds. The question of fertilizing the soil in order to reach the best results in fruit production is one which few understand fully, and none can wholly comprehend without study and thought along the lines which science has traced as a guide to the intelligent horticulturist. Chemical analysis alone can properly determine the composition of fruits or other products of the soil, and it is by a study of results reached in the laboratory, that the orchardist is enabled to apply to his soil the proper ingredients in right proportions to produce a crop. The chief and most expensive substances entering into the necessary food for fruit crops of nearly all kinds are nitrogen, phosphoric acid and potash. Without definite amounts of these substances to feed upon, a full crop of perfectly formed fruit is impossible. It should be understood by all orchardists that Nature is inexorable in her demands, and when she asks for bread she will not be satisfied with a stone. In other words, her call for nitrogen, phosphoric acid and potash must be heeded, or no crop. There is no appeal from this, and no orchardist should delude himself with the hope of deceiving her by substituting carbon, soda and magnesia or any other combination of ingredients, however captivating the name or small the cost.

Take an orange grove for example: At twenty-four feet apart the trees would stand at the rate of about seventy-five to the acre. At ten or twelve years of age many trees will yield, say, seven boxes of fruit per tree, weighing about 500 pounds. Let us see then the amount and cost of the chemical ingredients which must enter into that 500 pounds of fruit, and without which it will be impossible to produce that amount on one tree. The principal chemical substances to be found in the orange and derived from the soil are: Nitrogen, potash, phosphoric acid, soda, lime, mag-

nesia, and oxides of iron, alumina and manganese, also sulphuric acid, silica and chlorine. All save the three at the head of the list may generally be disregarded, since repeated analyses have shown most soils in which orange trees are planted in the United States to be fully supplied with the small amounts required save perhaps lime. But lime is abundant almost everywhere and cheap, hence we shall confine this discussion to the three chief substances required. According to analysis made at the laboratory of the California Experiment Station, 500 pounds of seedless oranges contain 1.6 pounds of potash, .27 pound phosphoric acid and .92 pound nitrogen. With the prices of 5 cents a pound for potash, 6 cents for phosphoric acid and 15 cents for nitrogen these ingredients entering into 500 pounds of seedless oranges (presumably the product of one tree) would cost 23.6 cents; or, if lime be required, say 25 cents per tree. At the prices given, the absolute requirements of the fruit in the way of plant food would cost at the rate of \$18.75 per acre. If the soil already contains all or any part of these substances, it would, of course, lessen the cost of the annual fertilization. And right here is where many orchardists—in fact most of them—neglect an opportunity if not a duty. They should have their soils analyzed for the chief ingredients here mentioned, and thus learn what they lack or how long the present supply will last. In fact, without some such guide, the orchardist is at a great disadvantage and must in a certain sense grope his way in the dark to reach results. But this is the requirement of the seedless fruit only, and takes no account of the growth of the tree itself and of the perfecting of the seed growth. For these purposes a further supply of each of the ingredients would be required, bringing the probable cost to 15 cents more for a tree large enough to bear 500 pounds of fruit. It is probable, therefore, that an orange tree producing as above stated uses each year some 40 cents' worth of fertilizing material. This must be already in the soil or must be put there by artificial means, else a crop to meet reasonable expectations cannot be produced. It is useless to attempt to replace one of these essential ingredients with some other substance. That is, the lack of potash cannot be supplied by an excess

of nitrogen, and *vice versa*. A chain is only as strong as its weakest link, and a fruit crop will be measured by the product due to the smallest amount of any needed ingredient which may be present in the soil. It is, therefore, of the greatest importance that a well-balanced ration of fertilizer be used so that the best results and no waste shall follow its application. If the soil be deficient in any one ingredient, putting on the others in excess will not bring a fruit crop. Most of these things are fairly understood by the foremost orange growers in Florida, but in California, owing to a richer soil, growers do not generally comprehend the science of fertilization. It is a common custom to apply nitrogenous fertilizers, such as sheep manure and that of dairies and horse stables, without much regard to other substances which a proper orchard fertilizer should contain. These things will all be learned in time, no doubt, but the object of this article is to call present attention to the great need of intelligent action along the line of fertilizing orchards, and if greater interest in the subject shall have been aroused the purpose of the writer will have been accomplished.

THE EASTERN STOCK FARMER SHOULD GO TO THE IRRIGATED WEST.

THE more I see of farming in the irrigated West the more I am convinced that our Eastern farmers have failed to appreciate the great advantages which irrigation offers to the producer of butter, cheese and pork, writes F. C. Barker, of New Mexico. In the first place, more milk and pork can be raised from an acre of irrigated alfalfa than from an acre of any other crop and at less expense. In the second place, dairy products and pork invariably sell for more money out West than they do in the East. For instance, in the town where I live fresh ranch butter is never worth less than 30 cents, and, although doubtless pure, will fall when we have a better supply, yet throughout New Mexico large quantities are still imported from Kansas, and it will be a long time before butter will sell for less than Kansas prices plus cost of express. Enterprising Eastern farmers who understand dairy farming ought to take advantage of this state of affairs and make their butter where it

sells for the most money. That butter, cheese, pork, poultry and eggs sell for more money in the irrigated West than in the East requires no proof at my hands. The immense shipments from points farther east prove this beyond any doubt.

The question which will naturally be asked by the farmer is, whether butter and pork can be raised as cheaply on an irrigated farm as in States like Illinois, Iowa, etc. Personally, I feel more certainty upon this point than I do upon the question of prices. The latter are liable to fluctuation and beyond the farmer's control, whereas the only variation in the cost will be in the direction of further economy as the farmer gains experience. Enough has already been done to show that no crop is so suitable for dairy cows and pigs as alfalfa. Under irrigation it produces at least three and often four or five cuttings, making a total of three to five tons of hay for the year, the feeding value of which is at least equal to the best timothy hay, indeed it is considered superior by every one who has had experience with both alfalfa and timothy. I give the estimates in hay because they are more easily compared, and after all hay must be the basis of all stock feeding. But alfalfa is not the only stock food raised here. Corn, sorghum and cattle beet can be raised with the greatest ease and under very favorable circumstances to the stock feeder, and bran is always obtainable at reasonable prices. And last, but not least, the open winters make stables quite superfluous.

Dairy Cows' Rations.—Experience by practical dairymen in each of the States mentioned show that the following are good rations for dairy cows: In Pennsylvania, 10 lbs. corn fodder, 6 lbs. hay, 3½ lbs. wheat bran, 1½ lbs. cottonseed meal, 1½ lbs. oil meal, 2½ lbs. corn meal. In Illinois, 7½ lbs. clover hay, 7½ lbs. timothy hay, 12 lbs. corn and cob meal, 8 lbs. bran, 1½ lbs. linseed meal, 1½ lbs. cottonseed meal. In Colorado, 30 lbs. silage, 10 lbs. alfalfa hay, 10 lbs. clover hay, 5 lbs. wheat bran, 2 lbs. corn meal.

Kansas Fruit.—As a fruit-growing state Kansas is making a record. During 1895 there were in bearing 7,529,915 apple trees, 186,874 pear, 3,790,692 peach, 883,874 plum, 1,451,716 cherry, making a

BIOGRAPHICAL SKETCH
OF
DR. WILLIAM MOORE WRIGHT.

[Reprint from **PHYSICIANS AND SURGEONS OF AMERICA.**]

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WILLIAM MOORE WRIGHT.

WRIGHT, William Moore, Huntingdon, Tenn., son of Dr. Ebenezer and Olivia A. (Moore) Wright, grandson of Moses Wright, of Worcester, Mass., was born November 6, 1838, at Liberty, Tenn. After obtaining an academic education in the schools of Huntingdon, he began to read medicine in 1859 in Huntingdon under the direction of his father, who died in January, 1860. He then went to St. Louis, Mo., and continued his studies with Drs. John T. Hodgen and A. S. Frazier. He attended the hospitals of St. Louis in 1861, also a course of lectures at St. Louis Medical College (McDowells), and in the early part of 1862, entered the Confederate service; was commissioned assistant surgeon and assigned to duty in the hospitals of Nashville, Tenn., Atlanta, and Augusta, Ga., with Dr. Paul F. Eve, until the close of the war. Returning to the study of medicine, he attended another course of lectures at the Missouri Medical College, St. Louis, receiving his degree from this college, with the class of 1869-'70. Since that time he has practised medicine in Huntingdon.

Dr. Wright is a member of the Carroll County (Tenn.) Medical Society; of the American Medical Association; was elected a member of the Tennessee Constitutional Convention of 1870; was superintendent of prisons for Tennessee, 1871-'75; was a trustee of the Tennessee Hospital for the Insane, near Nashville, Tenn., from 1875-'89; a trustee of the West Tennessee Hospital for the Insane, near Bolivar, Tenn., since 1889; has been a member of the United States medical examining board for pensions since 1890.

Dr. Wright has been one of the trustees of the Southern Normal University, Huntingdon, Tenn., since 1891; was a delegate from Tennessee to the National Prison Congress, Baltimore, in the winter of 1872, and in St. Louis in 1873; and was a delegate to the National Democratic Convention, St. Louis, 1876.

Married, October 6, 1870, Miss Charlie Erin Hanna, at Paris, Tenn. Their children are: James McNeill, Charles Hanna, Will Eben, Thomas McNeill, and Olive Wright.

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total of 13,843,071 bearing trees. In addition there were 6,646,560 fruit trees not in bearing.

Subirrigation.—The assertion has been made and reiterated that subirrigation is far superior to surface irrigation. To find out the results and differences of these different methods, experiments were begun in 1890 at the Utah Experiment Station and have been carried on five years. Following is a summary of the whole matter:

First.—On a poor clay soil containing gravel, with the cobble rock drain, or on a better clay soil containing some sand, with the cement tile, the subirrigation was not so good as the surface.

Second.—The experiment covers ten trials, and in every trial but one the surface irrigation gave the highest yields.

Third.—During irrigation the soil immediately over the rock drains or the plugs in the cement pipes was over saturated, while that between the drains or pipes and between the plugs in the pipes was very dry.

Fourth.—On the soil of the station farm the system of subirrigation has proved an utter failure for grain or grass. On soil containing more sand it may be possible and is highly probable that better results can be obtained.

Fifth.—The system is so expensive that it is doubtful whether it could ever be applied to general farming. The results are so discouraging that no one is advised to put it in except on a small scale for trial.

Subsoiling.—There is every reason to believe subsoiling to be a valuable aid to the farmers on much Oklahoma soil. Observations made at the Oklahoma Experiment Station at some points in the Territory where subsoiling has been tried show, however, that it is very desirable to combine with subsoiling the growth of deep-rooted plants and other means of getting vegetable matter into the soil, not only at the surface but as deep as may be practicable. A good deal of soil in the Territory is of such nature that it will become overly compact again even after thorough subsoiling. The more roots or other vegetable matter it can be made to hold, the longer will it remain loose.

More Ventilation.—The discussion of the subject of tuberculosis in cattle necessarily involves the subject of the causes of the same which are often found in illy ventilated barns. The tendency of the farmer in winter is to get a large amount of warmth for his cattle so as to save the cost of feed. To secure heat he has supplied little room for his cows and has shut out the cold air as much as possible. An authority upon the health of the cow says that the stable, to be healthy, should be well ventilated and free from draughts, and to accomplish this air should be admitted at the door line and sufficient space should be provided at the apex of the roof to allow the heated air to escape. Six hundred cubic feet of air is necessary for Shorthorns and their grades, and less, of course, for the smaller breeds.

Has Its Limitations.—Bran is much more highly thought of as feed than it used to be. But it has its limitations, and should not be relied upon entirely when fed alone. It is an excellent feed to give to animals that have a surfeit of corn, and should always form a part of the ration of fattening sheep. It is not so good for hogs, as its coarse texture makes it unpalatable. But fine wheat middlings have all the excellences of bran, and will be eaten in greater quantities by fattening hogs. The bran and wheat middlings furnish a greater proportion of albuminoids than corn has, and, therefore, supplement its deficiencies.

Advantages of the Irrigation Farmer.—The farmers of many portions of Texas and the West, generally, made fine crops last year, but our Pecos valley farmers have the comfortable assurance of just as good crops every year, while those in the districts depending on rainfall know that such another season may not come again in ten years. The irrigation farmer cares little for either a drought or a flood, as he is independent of each. In the first place floods are rare in the arid countries, and when they do come, in off years like the present one, the irrigated farm sheds the extra water as readily as it takes it in flooding the fields by irrigation. In short, the same preparation for flooding the fields prepares them for bearing off flood waters, while the rain farmer has to stand help-

lessly by and see much of his crop drowned by excessive rains. At many points corn is so plentiful that 15 cents is a good price for it, while here 70 cents is as cheap as any one has sold his crop of corn. The Pecos valley farmer can grow hogs enough on a few acres of alfalfa to use all the corn grown on a quarter section of ground, so that he can always market his corn at a good figure. The Pecos valley farmer who stays at home and attends to his business is the most independent man under the sun, for he is not mortgaged up to the eyes to the merchant, and he need never be. The Pecos valley farmer, one of whom we are which, is all right, with a bright and happy future.—*Pecos (N. M.) News.*

Lecturing the Old Style Farmers.—Time apparently hangs heavily upon many of our farmers. Prices of most of the products are so low that the business but little more than pays the running expenses. A radical change the whole length of the line is indispensable to anything like fair success.

Little less must be done, and accomplished in a great deal better manner, says *The American Cultivator*. It is entirely idle to expect to secure a profit over the cost of production of ordinary to poor goods. The best horses, the best cattle, sheep, dairy products and the like usually pay a good profit, and why? Because it does not cost so much to produce good stuff as the poor stuff costs.

The farmer who raises a good horse or a good ox wastes no feed. His feed is all food of production; he don't feed them a day without some grain. A good dairyman will make as much product from two cows as a poor one will from six. The good dairyman not only feeds the food of support, but as much of the food of production as his cows will bear and respond to, while the poor dairyman rarely finds much above the food of support, and of course loses most of that.

Farmers do not sell quite so much fertility when they sell stock as they do when they sell hay. If our farmers could provide themselves with first-class stock and learn how to feed it and care for it, they would rise in the scale of being in short time. It is their only way out. As a rule, from three to eight horses are kept

on a farm, and not a good one among them.

All This and More too.—On the subject "What the Granges Have Done," Senator Chandler of New Hampshire says: "They have promoted and secured their most natural object, better and more profitable agriculture. They have taken up by many wise heads the various questions of importance to farmers; have investigated and studied those questions; have searched the world over for answers, and at last many quick hands have put into practice and proved the soundness of the conclusions reached. There is hardly a method of farming which has not been improved through the influence of the granges. Better market gardening, better flowers, better staple crops, better forestry are the result of the inquiries, discussions, plans and experiments of the granges of America. This most fruitful subject of the results of grange action I leave to be amplified by others."

Butter and Eggs.—Poultry and eggs sold in Kansas during 1895 were valued at \$3,315,067. During the same period butter to the value of \$4,050,048 was sold.

Exercise is of the utmost importance for laying hens. One ounce of salt per day for one hundred hens is a good proportion. Supply grit liberally. Give the hens plenty of room and keep them warm.

Four hundred thousand sheep will be sheared in the pens around Casper, Wyo., this spring.

The Warren Live Stock Company of Cheyenne, Wyo., fed their sheep at Duncan, Neb., during the winter, shipping as many as eight carloads at a time to Omaha. The sheep were in prime condition and brought top prices.

The live stock industry of Kansas last year brought returns of \$40,691,074 for animals sold.

Fred Wachter raised 5,400 bushels of corn this year in this county from 120 acres, and did all the work himself, except six days' work cultivating. This beats the Iowa man and his two small boys, who raised 5,000 bushels, which is being so extensively quoted in the newspapers.—*Aurora (Neb.) Sun.*

MANUFACTURES AND TRADE

NORFOLK, Nebraska, has a candy factory.

BOZEMAN, Montana, wants a creamery.

A LATE report says frost has injured the fruit in Arizona.

A COLONY of Dunkards is to locate in the Grand Valley, Colorado.

IRRIGATION will be tried on 100 acres of bottom land east of Atchison, Kan.

THE Western Nebraska fair will probably be held the latter part of August.

AMERICAN Investments rises to ask if we regard irrigation as an "art." We do.

CONNECTICUT claims to lead the New England States in the matter of irrigation.

THE Iowa legislature has passed a bill forbidding the manufacture or sale of cigarettes.

LINCOLN, NEBRASKA, will be the scene of the State Grand Army reunions for the next five years.

THE creamery at Albion, Neb., paid the farmers in that locality \$17,500 for milk, butter and eggs last year.

NEBRASKA, Missouri and Iowa are following the lead of Kansas and planting a large acreage to Kaffir corn.

IDAHO has repealed the law providing that the obligations of the State might be paid in either gold or silver.

A NUMBER of settlers from Idaho have laid out a new town to be called Grand Teton, near the Gros Ventre river.

A PARTY of 100 families from Arkansas and Iowa are going West to settle in the Jackson's Hole country, Wyoming.

A VINEGAR factory has been started at Albion, Neb., by Sylvester V. Parrot. Sugar beets will be used exclusively.

WASHINGTON has over fifty creameries, and the output for last year was about 2,500,000 pounds of butter, valued at \$312,500.

STATE Labor Commissioner Bird estimates that there are \$100,000,000 invested in manufacturing plants and raw material in Kansas.

THE Anthony salt plant has been sold at sheriff's sale for \$4,000. The city of Anthony, Kans., invested \$23,000 in this plant a few years ago.

THE Red Lake and White Earth Indian Reservations in Minnesota comprising 890,745 acres of land will probably be thrown open for settlement about June 1.

SHALLOW artesian wells in South Dakota cost from \$50 to \$300. Deep wells ranging from 500 to 1,500 feet cost complete about \$3.00 a foot. There about 400 shallow and 150 deep wells in the State.

PRESIDENT J. J. Hill of the Great Northern Railway Company has purchased 300 acres of land on the west side of Great Falls, Mont. This will no doubt be made the terminal grounds of this company.

THE fast-thriving little city of Havelock, Neb., five miles east of Lincoln, on the main line of the Burlington railroad, is surrounded by a very fertile agricultural region, and is soon to become one of the important manufacturing points in the West. The principal shops of the Burlington & Missouri River railroad are located here, employing about 400 men and maintained at an annual expense of nearly half a million of dollars.

CANADIANS took the initiative in an international deep waterways convention held in Toronto during the summer of 1894. This was followed by another convention in Cleveland and more recently by one in Detroit. There is already uninterrupted passage from Chicago and Duluth to Buffalo for vessels drawing twenty feet of water, and the aim is to have the channel completed by deepening the canals between Buffalo and Montreal or New York. Community of interest among grain growers in the great West on both sides of the line has joined them or rather those who speak for them in a common effort to perfect water communication from the head of Lake Superior to the Atlantic seaboard.

MINES AND MINING OUTPUT

ANACONDA, Mont., is to have a smelting plant.

THE Salt Lake Mining Exchange is a success.

SHERIDAN, Wyo., is to have a mining exchange.

NEBRASKA has an acute attack of the gold fever.

CRIPPLE CREEK now has a population of 60,000. In 1892 it had 1,500.

It is estimated that this year's output at Cripple Creek will reach 20,000,000 tons of ore.

THE annual capacity of the three smelters already erected in West Kootenay is given as 164,250 tons.

EXTENSIVE deposits of onyx have been discovered on the Big Laramie river within eight miles of the Cheyenne & Northern railway.

THE mining fever has struck Wheatland, Wyo. Several discoveries are reported from the country surrounding the busy little town.

It is estimated that 500 claims in the Cripple Creek district on which the owners failed to do full assessment work in 1895 have been jumped.

THE West has not a monopoly of the gold supply, although it has little to fear from competition elsewhere. The following is the gold output of Southern mines up to December 31, 1893: North Carolina, \$11,726,629.90; South Carolina, \$2,221,590.90; Georgia, \$9,112,328.05; Alabama, \$242,994.19, and of Virginia, \$1,754,785.02.

THE mineral output of Idaho in 1895 was as follows:

	Quantity.	Value.
Gold, fine ounces.....	125,517	\$ 2,594,666
Silver, fine ounces.....	4,030,180	5,214,498
Lead, pounds.....	65,752,037	2,301,321

Total.....\$10,110,485

This is an increase of \$316,405 over the previous year.

SHOSHONE county, Idaho, produced 63,861,660 pounds of lead in 1895.

THERE is \$96,325,122 of capital invested in the Lake Superior iron mines and their equipment; and in docks and railways and vessels for the exclusive transportation of ore, from the upper lakes to Lake Erie ports, etc., \$136,916,963, making a total of \$233,242,085.

THE largest gold brick ever cast in the Black Hills was recently deposited in the First National Bank of Deadwood. It came from the Cyanide Works, weighed a trifle less than 125 pounds, and was worth about \$30,000. It was the result of a fifteen days' run.

THE Golden Fleece Mining and Milling Company of Lake City, Colorado, reports:

Production of mine from Sept., 1892, to Jan., 1896.....	\$729,262.19
Less expenditure, Sept., 1892, to Jan. 1, 1896.....	\$209,149.88
Less Insurance and Construction accounts.....	4,680.76
	<u>213,830.64</u>
Balance profit.....	\$515,421.55
Dividends paid.....	401,979.85

Surplus on hand Jan. 1, 1896.....\$113,441.70

THE Chicago Mining and Mineral Board have adopted the following rates:

	Per 100 Shares.
Stock selling at 25c and under.....	\$ 25
Stock selling at over 25c and under 50c.....	50
Stock selling at over 50c and under \$1.....	1 00
Stock selling at over \$1 and under \$2.....	2 00
Stock selling at over \$2 and under \$5.....	3 00
Stock selling at over \$5 and under \$10.....	5 00
Stock selling at over \$10 and under \$20.....	6 25
Stock selling at \$20 or over.....	12 50

FOR the first time in the history of Colorado, the gold output for the year just closing exceeded in value that of silver. A careful computation of the mineral output for the year from the statistics attainable shows the following: Gold, \$17,340,495; silver, \$14,259,049; lead, \$2,955,114; copper, \$877,492; total, \$35,432,150. For 1894 the output was: Gold, \$11,235,506; silver, \$14,721,750; lead, \$3,268,613; copper, \$767,420; total, \$29,993,290. The increase in gold production is almost wholly from the Cripple Creek district.

LIVINGSTON, Mont., wants a smelter.

THERE was no smelter in the Black Hills from 1876 to 1882.

An appropriation has been made to run the mint at Carson, Nevada, another year.

THERE is a field for the development of copper properties in the Yellow Jacket District, Idaho.

THE waterpower plant at the mine of the Boston and Montana Company in Montana has a capacity of 7,500 horse power.

THERE are two feet of solid copper ore and twelve feet of free milling gold ore on the Indian Claim in the Yellow Jacket District, Idaho.

It is claimed that there are deposits of very rich gold quartz in Southern Oregon, although placer mining has attracted most of the attention heretofore.

THE Western Mining World says it is scarcely possible to glance through a paper published anywhere in Idaho without reading of new mine discoveries or increased prosperity in the mining industry.

The report of the Minister of Mines of British Columbia shows the output of gold by districts as follows: Gold mining engaged the attention of, on the average, 1,050 white men and 979 Chinese and Japanese, besides those engaged in Trail Creek division, the newest as well as the richest in the province, but for which unfortunately no gold returns were sent in. The output of the others was, by districts, as follows: Cariboo, \$282,400; Cassiar, \$22,575; East Kootenay, \$17,575; West Kootenay, \$10,520; Lillooet, \$40,663; Yale, \$237,311, a total of \$636,544 of the yellow metal, exclusive of the Trail Creek division, as previously mentioned. Of this total all came from placers except \$135,000 from the quartz mines at Fairview and Camp McKinney. Even without Trail Creek the returns for 1895 are the largest since 1878, new methods having brought about a revival of the industry in temporarily abandoned fields. Since the beginning, in 1858, \$55,000,000 in gold has been taken from the fields of this province. Appended to the gold statistics is the statement that in 1895 the gold, silver and lead in the ore from Kootenay was estimated at \$2,176,000.

BRITISH COLUMBIA also claims to have oil fields.

ALASKA's output of gold last year is estimated at \$3,000,000. Of this \$800,000 came from the Yukon placer mines.

COAL mining made no progress in British Columbia during 1895. There are immense quantities of coal, but it can not be mined to advantage until the fields are reached by the railroads.

THE production of the oil field for the past year was nearly three times as great as that of the previous year, amounting altogether to 1,368,750 barrels. The average price received was 50 cents per barrel, or \$684,375 for the entire output. According to the estimate of the oil exchange, there are 250 wells which have been operated during the year, the mean product of each being about fifteen barrels daily.

The mineral bearing portion of the Belknap Indian reservation in Montana that will probably be declared open for entry within the next six months, is located on the north slope of the Little Rocky Mountains, covering an area of nearly thirty-five square miles. This area is almost wholly made up of abrupt porphyry buttes and steep, broken mountains. The drainage of the district is by tributaries of Milk river; three large creeks issue from this district out onto the vast plateau lying between the Milk river and the Little Rockies.

SINCE 1890 the gold in European banks has increased by \$623,200,000. Of this the Imperial Bank of Russia has gained \$185,800,000, the Bank of France \$167,400,000, the Bank of England \$111,000,000, the Austro-Hungarian Bank \$79,800,000 and the Imperial Bank of Germany \$39,000,000. The gold comes from the American monetary circulation and from the production of the gold mines. At the end of 1895 the Bank of France and the Imperial Bank of Russia between them held \$776,600,000 in gold, a little more than half the stock of gold in the European banks, and this does not include the gold in the Russian treasury, which is estimated at \$510,400,000. The gold in Germany, Austria-Hungary and Italy amounts to \$336,000,000 and that in the Bank of England to \$580,800,000.

PULSE OF THE IRRIGATION INDUSTRY

EAST AND SOUTH CATCH THE IRRIGATION FEVER.

THE agricultural papers of the East and South are discussing irrigation. Various experiments have been made during the past season in portions of Pennsylvania, Ohio, New York and New Jersey; also in North and South Carolina and other Southern States. The results have also attracted the attention of the daily press, and lengthy articles are being published. Wonderful as these achievements are in the Southern, Eastern and Middle States, they are eclipsed on the former arid lands of Western America because of the more thorough irrigation there. An elaborate, displayed article of several columns in the New York Times will do a world of good in waking up the old style farmers of the entire country. The following is an extract:

Not the least remarkable of the many picturesque anomalies which the cosmopolitan population of Long Island City presents is a colony of Chinese farmers, located on a high bluff overlooking Bowery bay. It was founded a few years ago by Shen Ho Joe, the son of a mandarin who made a fortune in the cultivation of every form of growing thing which flourishes within the great wall of China. Previous to the advent of Shen, the Chinamen of New York and the neighboring cities were forced to depend upon the Pacific coast for vegetables of their own peculiar cultivation.

Shen's initial effort created a commotion among the truck farmers of Astoria. His beans were as large as an ordinary-sized radish, and all the other celestial vegetables were the envy and admiration of the neighborhood. The gourmets of Mott street were in ecstasies of delight over the new venture and the demand for Shen's vegetables far exceeded the supply. In order to meet the growing demand for garden truck which came from Mott street alone, five other Chinamen

started rival farms adjoining that of Shen Ho Joe a year afterward. Shen meanwhile had established a prosperous line of trade and had saved a snug sum of money from the proceeds of the first year's crop.

In the spring of the second year he sunk two wells on his farm for irrigation purposes and built a sausage factory and a large manure tank, from which liquid fertilizers are spread over the ground by means of a rubber hose. This innovation revolutionized Chinese farming in Astoria. The same kind of soil afterward yielded twice as much net for Shen as for the others. Of course, gradually, the influence of this progressive man extended throughout his neighborhood, and the old-fashioned methods of watering and manuring the ground soon gave way to new methods. The Chinese farmer from time immemorial has been a great believer in irrigation.

At the end of the third year Shen Ho Joe had acquired a competence and sold out his farm. With the proceeds of his three years' venture he sailed for China, leaving Yu Lee, Yung Gee Tschiu, Chu Lick and Yumb Yab in undisputed possession of the field.

The soil of the celestial farms is sandy and poor. The fields are divided into squares called wells, from their resemblance to the Chinese character signifying a well, surrounded and furrowed by ditches.

There are upward of fifty different kinds of vegetables grown on this celestial farm.

DR. RUSK ON THE MORMONS.

The Rev. Dr. John Rusk, of the Militant Church, Chicago, is not following the policy of the ordinary orthodox preacher. He is taking up live subjects of interest at present. In a recent sermon he referred to the enterprise and thrift of the Mormons. "A man's share in what is going on in this world is not a dog's share nor a hog's share, but a man's share," he

CLESSION S. KINNEY, OF UTAH

The author of the articles on "Irrigation Legislation" now appearing in THE AGE.

said. "How shall he get a man's share? By getting a home. The Mormons settled that in a superb way. They traveled West till they came to the superb valley of Salt lake. Brigham Young's plan was to have every man at work and every man in a home. A home a man's share. Not only that, but he overcame the isolation of agricultural life by settling a town with farms about it. He kept his people from mines, the thirst for gold, and held them to land and home. In addition, he associated his people so that they operated factories, mills, railroads, telegraph lines, stores and all that pertain to life in a community. It has become the example and pattern of the new colonial movement, and its success means hope for the city-bred man as well as the farm born. Whilst I must dissent from polygamy with all my being, I must say that it is the only religion which compels every man to own his own home. It teaches that no man has a right to own one more acre than he can use, a great Christian lesson of unselfishness. They found a desert and made it a paradise, because they taught that God made the earth for all and not for a few. Necessity taught them that no man

had a right to waste one drop of the precious water with which they irrigated their lands; their religion and the religion of Christ teaches that a man has a right only to so much of God's land as he can use. The Mormons are not allowed to fence in a prairie, nor are they rewarded for keeping land idle by having taxes reduced. It is a part of their religion to make the waste places blossom forth and to turn idle lands over to the industrious to improve and own what they do improve and use, but not one acre more. That religion places a premium on industry and unselfishness; that part of it is Christlike, and they live nearer Christ in this respect, far nearer, than the vast majority of so-called Christian people. Fully 98 per cent of the Mormons own their houses and the land on which their houses stand. I want to see the time when every Christian owns his home. I want to see a practical use of the Christian religion as I believe Christ intended it. I have visited the Mormons and found them most delightful and companionable, all of them industrious, and many highly cultivated."

VALUABLE STATISTICS.

The assessable property of Arapahoe county, Colo., is reported at \$82,133,000.

Nebraska has 352,028 children of school age. According to the usual calculations this would indicate that the State has a population aggregating 1,760,000.

The general land office report for the fiscal year of 1895 shows some very interesting figures relative to the business transacted by the local land office in North Dakota. At the Bismarck office 887 entries, covering 138,000 acres, were made. The total receipts were \$14,116.09. Devil's Lake land office shows 1,067 entries, and total receipts of \$19,441.56. The Fargo office shows 766 entries and total receipts of \$9,755.25. The Grand Forks office shows 1,234 entries, and the receipts were \$20,193.52. The Minot office shows 86 entries and receipts of \$1,105.77.

The total of land transfers for last year was 132 millions, an advance of twelve millions over 1894. There is a falling off of forty eight millions as compared with 1891 or 1892, but it must be remembered that there was a great amount of specula-

tive dealing in real estate during those years, and some property changed hands many times. There is no reason to find fault with the volume of business for 1895.

In 1860 the assessed valuation of Washington was \$4,394,735, with a population of 11,694; in 1870 the valuation had increased to \$10,642,863, with 23,955 population; in 1880 the valuation was \$23,810,693, with 75,116 population; in 1892 the valuation was estimated at \$400,000,000, with 375,000 population. To-day it is estimated at \$450,000,000, with the population estimated by Governor McGraw at 415,000 January 1, 1896. The state is in good financial condition, with a low rate of taxation.

The population of Nebraska is 1,058,910. Value of improved farms in 1890, \$402,358,913. Value of property per capita, \$1,205. Total valuation of real and personal property, \$1,275,685,514. Value of manufactures at the last census, \$93,037,794.

Kansas has a native population of 1,206,332; foreign, 128,402, making a total of 1,334,734. The percentage of foreigners is very small. Over 30,000 people have moved to Kansas from each of the States of Illinois, Missouri, Iowa, Indiana, Ohio, Nebraska and Pennsylvania, Illinois leading with 145,449 and the others following in the order named.

The total assessment last year on railroad property of the Santa Fe alone was \$68,309,321; the tax paid on that, \$1,744,761, which, with the addition of the tax on town lots, lands and auxiliary companies, made the total amount about \$2,000,000. The highest rate last year was 3.67 per cent in Oklahoma; the lowest rate, .97 per cent in Texas. The highest rate of taxes per mile, \$504, paid in Iowa; the lowest rate per mile, \$96, paid in Texas. The Company pays more taxes in Kansas than in any other State; the total sum this year will be about \$800,000, a rate of 3.5 per cent, or nearly \$300 per mile.

The assessed valuation of property in Utah in 1895 was \$97,983,525. The total export value of the mineral product in 1895 was \$8,312,352. Computing the gold and silver at their mint valuation, and other metals at their value at the seaboard, would increase the value of the mineral product to \$14,519,959. There

are 19,816 farms in Utah, and 17,684 of them are absolutely free of incumbrance. Total acreage irrigated, 417,455. The amount of ranch and range was \$1,259,566 in 1894. The number of industrial concerns was 880 in 1894, employing 5,054 laborers, paying in wages \$2,275,118, representing a total capital invested of \$46,417,246, and turning out a product of \$6,678,118 annually. The population of the State is 247,326.

WHAT THE TORRENS LAND TITLE SYSTEM IS.

Chicago, in the recent election, adopted the Torrens land title system, and there is general interest throughout the West to know what that system is. It has been in successful operation for years in England, Prussia, Australia and in different parts of Canada, and it has proved wherever tried to be in the interest of the whole people. Sir Robert Torrens, from whom the system was named, once spoke of the benefits of it in this manner: "It has substituted security for insecurity; it has reduced the cost of conveyances from pounds to shillings, and the time occupied from months to days; it has exchanged brevity and clearness for obscurity and verbiage; it affords protection against fraud; it has largely reduced the number of chancery suits by removing those conditions that afford ground for them." By act of the legislature last June, the Torrens system became a law of the State of Illinois "in such counties of the first class as shall approve of said act by a popular vote." Cook county (Chicago) so approved. The evidence of a title registered under the Torrens system is a single paper—a certificate of title. Abstracts are, under this system, done away with. Titles will be registered upon the public records upon the judgment of the registrar and two expert examiners that there is a good title. There is a five years' limit for the contesting of the titles registered, and after the expiration of this period this certificate is a first evidence of ownership, and is incontestable. No one can deny your title. When a transfer is to be made, the owner presents the deed, together with the certificate of title, to the registrar, the deed merely authorizing him to transfer the property on the public records to the purchaser. All questions concerning the validity of that transfer are settled at that time and forever. The saving in expense and delay are great items.

SUGAR BEETS.

A beet sugar convention was lately held in Fremont, Neb.

Twenty-five hundred acres will be sowed to beets in the San Juan valley in California.

The people of Chadron, Neb., have raised \$25,000 to give as a bonus to the establishment of a beet sugar factory.

Over 450 acres of beets were raised in Clay county, Nebraska, last year, bringing the grower the contract price of \$5 per ton.

The Oxnard Beet Sugar Co., of Grand Island, Neb., agree to pay \$5 a ton for all beets with 12 per cent of sugar, and a graded scale for beets that fall below that percentage.

A bill has been introduced in the Iowa legislature calling for a bounty of one cent a pound on sugar manufactured from sugar beets, sorghum or cane grown within the limits of the State.

The fifteen sugar factories in Sweden worked, in the campaign of 1895-96, 538,708 ton of beets, and the refineries produced, from October 1, 1893, to September 30, 1894, 63,650 tons of refined, and, in the same period 1894 to 1895, 72,298 tons.

At the meeting of the Beet Growers Union in Chino, Cal., recently, the permanent organization was completed by the election of W. T. Hayhurst as president; Elmer Scott, vice-president; W. Baker, treasurer; W. M. Monro, secretary, and E. M. Day, W. M. Monro and W. Baker as executive committee.

In Utah it is stated that the average cost of cultivating, harvesting and delivering a crop of twelve tons of beets per acre is from \$28 to \$35, and with the average yield last year of 11.54 tons an acre the farmer has an income of \$49.05 an acre or a net profit of from \$14 to \$21, besides getting \$28 to \$35 in cash for his labor.

NEBRASKA CANALS.

Canals for irrigation purposes in Western Nebraska are making considerable headway and quite a number are in successful operation for a part or the whole of their length. The best and latest estimate of the mileage of constructed and proposed canals is something over 2,000 miles, of which 1,250 are now completed and the

remainder under way. This mileage is divided among 389 claimants of water under the State law. There are supposed to be almost or quite as many projects in existence or active preparation whose promoters have not yet made formal application to the authorities, but it is presumed that these are generally of small size and of less general importance. More than a million dollars has already been expended in irrigation works, and as much more will be required to complete the State's system. The number of acres of land covered by constructed ditches is about 854,000—by this is meant land to which water may be applied. The area really in crop under ditch for 1895 is less than 150,000 acres, but it will be more than doubled this year.

BOOKS AND MAGAZINES.

No publication that comes to our table is more welcome than that special exponent of Southern California most appropriately named "The Land of Sunshine." We may also add that no publication with which we are acquainted has a more distinctively local color and flavor than this, and the color and the flavor are both well pleasing. One fault we must allege, if it be a fault; and that is the habit so common among politicians during election times of claiming every thing in sight. It does not seem at all probable that an All-Wise Providence ever intended that all the good things of this world should be packed away in one corner thereof to the exclusion of all the rest of creation. As we study this great law of compensations, which seems to pervade the whole universe, it seems much more likely that when we put every advantage and disadvantage into the balance, the sum total of the differences between men and places is much less than we are generally willing to allow.

However, when every item is set down on both sides of the book, California of the South is still a land of beauty and richness; a land of corn, and wine and oil; a land to which all of us who have ever lived there hope some day to return; and meantime we have many a backward glance over the shoulder, and many a long drawn sigh of discontent. It is a land of eternal beauty and "The Land of Sunshine," is worthy of its habitat.

Dr. CHAS. STIRLING.

The April number of Scribner's Magazine contains an article by Henry Norman on the "Quarrel of the English-speaking Peoples." Mr. Norman was the correspondent sent to this country by the London Chronicle during the Venezuela affair. There are a number of very interesting articles in the April issue.

The April McClure's will contain what is about the first really authoritative and direct account yet given of Professor Röntgen and his discovery of the cathode rays. Immediately on the announcement of the discovery, the editors of the magazine cabled Mr. H. J. W. Dam, of London, to hasten to Würzburg, and talk with Professor Röntgen in his laboratory, and learn all there was to be learned of the new marvel in photography. The paper will be illustrated with a portrait of Professor Röntgen and numerous photographs by the new process. A supplementary article by Cleveland Moffett will tell what has been done in America with the cathode rays.

The Lincoln paper in McClure's for April will describe Lincoln's first debate with Douglas—twenty years before the famous debate of 1858—with passages from an almost unknown speech of Lincoln's in reply to Douglas. It will also contain the true story of Lincoln's courtship and marriage, clearing away forever a mass of scandal and falsehood that gossip has piled up regarding these incidents in Lincoln's life. Portraits of Lincoln and Mrs. Lincoln and numerous other pictures will accompany the paper.

THE CATHODE RAY.

It may be briefly explained, without going into the details of a very technical subject, that ordinary light is regarded as due to vibrations which are at right angles to the direction in which the ray travels, but that in the mathematical theories of light, other vibrations, in the direction of the ray, are indicated, though wholly unknown in experience hitherto. If the new rays prove in fact to be of this character, so as to realize indeed the long sought longitudinal vibration, the discovery is of the first importance in science, and will hardly find its equal in interest since the discovery of the law of gravitation; for it reveals a new mode of action of force,

governing a wide range of phenomena and effects which, until now, have lain entirely outside the bounds of our cognizance.—*Prof. A. W. Wright, in the April Forum.*

SIR JOHN MOORE'S RETREAT.

The tale of Moore's splendid retreat, of his courage and calmness in loss and disaster, of his superb control of his men in their disappointment when Corunna was reached and no fleet was found there, of his brave fight with Soult on January 16, of the mortal wound which struck him down in the hour of victory, and of the self-forgetfulness which enabled him in the agonies of death to make all necessary arrangements for his men to embark on the belated ships—all this is a brilliant page of English history, perhaps the finest record in its course of glory won in retreat, of patience, moderation, and success in the very hour of bitterest disappointment. It was the spirit and example of Moore which made possible the victories of Wellington.—*Prof. Sloane's "Life of Napoleon," in the April Century.*

The American Book Co., of New York, have issued a valuable little book on the trees of the Northern United States. It gives the name and characteristics of each tree, describing in detail the bark and leaves. It is fully illustrated. The title is "Apgar on the trees of North America."

F. W. Woll, of the Wisconsin experiment station, is the author of a valuable work entitled "Agricultural Calendar for 1896," issued by John Wiley and Sons, of New York. It is filled with information for the farmer, fruit grower and stockman.

The Review of Reviews for April is an unusually full and complete number. Some of the features are the most interesting that have appeared in many months.

DURING the year just ended, gifts to the value of \$28,943,549 were made to churches, colleges, libraries, charities and the like, aside from their ordinary income, as against \$19,967,116 in 1894.

THE new state of Utah will start in by making a jury consist of eight persons instead of twelve.

THE EDITOR'S DRAWER

THE Kansas oil fields are being developed.

MONTANA shipped 306,460 head of cattle in 1895 valued at \$11,032,560.

A BILL has been reported favorably by the committee on territories of the United States Congress to admit a delegate from Alaska, thus making it a full-fledged territory.

THE Canadian government has decided to continue the Chicago immigration office under the control of Peter F. Daley who has been doing such good work in behalf of the Northwest Territories.

SENATOR HANSBROUGH and Representative Cooper have introduced bills in the Senate and House respectively, to incorporate the Maritime Canal of North America to connect the Great Lakes and Hudson river. The capital stock is to be \$10,000,000.

IRRIGATION has proved itself the one great necessity for Idaho and the press and the people are co-operating for extensions of the great improvements already established. Numerous new irrigating companies have been incorporated the past season.

JAMES B. ANGELL of Michigan, John E. Russell of Massachusetts, and Lyman E. Cooley of Illinois have been appointed by the President as commissioners to make inquiry and report upon the feasibility of a deep water canal between the lakes and the Atlantic ocean, under the act approved in March last.

THE Torrens Land Law is proving a success in Cook county, Illinois. It is the means of saving a great amount of time, annoyance and expense in the transferring of real estate or in borrowing money thereon. The abstract companies are naturally opposed to it but its utility has now been practically demonstrated.

THE Western Mining World comes out in a bold stand against the statements of the Northwest Magazine that the West is destined to be an arid region forever.

The Northwest Magazine has nearly always been inclined to look with disfavor upon anything tending to develop the irrigation possibilities of the Western States.

THE Burlington railroad has 50,000 acres of land for sale in Nebraska, principally located in Webster and Franklin counties in the southern part of the State, and in Antelope, Sherman, Greeley and Valley counties in the North Platte district. The land commissioner at Lincoln, Neb., is disposing of these lands on very reasonable terms.

THE following prices show what the choice grain lands of the San Luis valley are worth to practical farmers. Ten quarter sections were sold bringing about \$20,000, without improvements. The best forties sold as high as \$25.25 per acre for the bare land, and the poorest for \$6 per acre. The average of 1,600 acres was \$13.32 per acre for the land only.

KANSAS has again come to the front in spite of the retirement of Mary Ellen Lease. This time it is a corporation in which membership is conditional upon being in debt. It is named the Montgomery County Mortgage Relief Association. It is intended to accumulate a reserve fund by regular assessments and this fund will be used by such members as are particularly hard pressed by creditors.

RUSSIA has a system of government banks for loaning money to farmers. They number thirty-six, all but three being restricted to specific territory. There is no competition of any kind, and the rules and regulations are carefully drawn. The last statement shows \$600,000,000 loaned on land and \$250,000,000 on buildings, in mortgages of periods varying from one to sixty years. These banks are authorized to issue bonds to ten times their capital, but never to exceed the loans on real estate made by them. They are issued at par and to a certain extent pass as currency, being frequently used to cancel mortgage obligations.

TOPICS OF THE TIME

The Bills in Congress. There are now pending before the Senate and the House of Representatives a number of bills pertaining to arid lands, reservoir sites and water supply and the preservation of the forests. One of the most important of these is the bill for the appropriation of funds to carry on the work of surveying and gauging the flow of Western streams. The question of water supply is of all others the one most important. This must be definitely ascertained and found to be adequate before there can be any security either for the capital which makes possible the building of the canals; or for the settler who tills the soil and to whom every drop of water is precious. Should Congress appropriate a half million dollars or more for this purpose it would not be out of harmony with its importance but to expect results from the expenditure of the diminutive sum of \$700 in such States as Colorado or California is ridiculous. The men who have this work in hand are energetic, intelligent engineers and every dollar which is spent in the hydrographic survey will be returned many fold in the benefits which will accrue to the Western States.

An Educational Campaign. Educate the people. It is an old axiom that an educated people will not be serfs or slaves. The ancient Saxon gloried in the fact that his long hair waved over the neck of a "free man." One of the needs of the American people today is an educational course in irrigation. Could they but rise to a full understanding of the benefits derived from the application of water in the proper quantity at the right time, and the possibilities of an improved industrial and economic system which radiate therefrom, the cry of hard times, of the unemployed, of suffering women and children would soon cease.

Within its scope, irrigation comprehends not alone the giving to thirsty plants a drink, but it opens avenues through which

will tramp an army to reclaim and settle the vast areas of arid land, to build thereon comfortable homes; to engage in every form of industry, and to erect social institutions which as nearly as possible will place men upon an equality.

The West Must Work out its own Salvation. There has been an inclination in certain quarters to sit idly by and wait for the National government to take up on an extensive scale the work of reclaiming the arid lands. While it is true that it is the duty of the federal government to undertake a large portion of this work, it is also true that until the representatives in Congress from the States east of the Mississippi can be brought to a full realization of the needs of the West it is useless to hope for much assistance from this source. But this is no reason why nothing should be done. Cannot the West work out its own salvation, even though the tools at command are not what might be desired? They will do good work if in proper hands. There are innumerable things that can be done, and when these are accomplished if a united front is presented it will be much easier to obtain a favorable reply to the requests made of the Congress at Washington.

Water Power and Electricity. The constant improvement in the methods of utilizing electrical force in the numerous industries is opening a wide field for the development of the mountain regions. The vast water power which goes to waste is being harnessed and placed at work. Already in some portions of Colorado, California and Utah the tremendous fall of the mountain streams is turning water wheels and turbines, and the electric current generated is carried for miles on wires until it is finally used for turning the wheels of factories, propelling the cars on the street railways, and furnishing light and

heat for homes. Through this one medium alone the development of the West will receive an impetus which will carry it forward with giant strides. Its full significance can scarcely be realized at the present time.

The Revival in the Northwest. The wave of irrigation fever, which has swept over the Northwest during the past few months, has resulted in the organization of numerous associations for the purpose of developing and exploiting the resources of the individual States and thus inducing the immigration of a class of progressive and intelligent people. South Dakota has already put in practical operation the machinery for the carrying on of this work. Committees have been appointed and instructed to go to work immediately. Arrangements have been made to publish a large volume giving, in detail statistics and a full description of the resources of the State. The leaders of this movement are energetic men, prominent in business, professional and political circles, and they have the welfare of the State close at heart.

What will the next Congress Do? The work to be done both before and at the Fifth National Congress is of the utmost importance to the irrigation cause. The cession of the arid lands to the States is not a live issue at present, but the questions of interstate and international waters, reservoir sites, the preservation of the forests are resting uneasily and some definite action should be taken. There are a number of questions relating to both State and federal irrigation legislation which must be discussed and a definite policy decided upon. It is to be hoped that the State commissions will pre-

pare full and careful reports, setting forth the needs of each particular State and some practical method of accomplishing the desired end. It is also to be hoped that little if any time will be devoted to lengthy papers on the proper methods of irrigating cabbages and topics of a similar nature. While subjects of this kind are of importance to the practical irrigator, they should not be allowed to occupy the time of the National Congress to the detriment of matters of far greater consequence. Above all, if the next Congress is to be a success it must not result in mere talk. Action, quick decisive action, is demanded, and if it is not forthcoming, the cause of irrigation and the West will be retarded instead of assisted.

Patronize Home Industry. The key to prosperity, whether in a town, a country, a state or a nation is, Patronize Home Industry. This doctrine is particularly applicable to the Western States. Why should Washington export lumber and import furniture made therefrom? Why should Montana export cattle and import canned and cured meats from the packing houses of Chicago, Omaha and Kansas City? Innumerable instances might be cited of the same peculiar condition of affairs and it is time that an organized movement was instituted in each State for the encouragement of local industries. Is it necessary for the people of Colorado to go outside the limits of the State for articles which can be produced advantageously at home? Why pay freight both on the raw material and the finished product? The Eastern manufacturer is merely waiting for an invitation to move nearer to the source of material supply and a market. Will he be invited?

MACHINERY AND APPLIANCES

WATER POWER AND ELECTRIC PLANT.

The accompanying cut illustrates a special water power plant constructed by The Stilwell-Bierce & Smith-Vaile Co., Dayton, Ohio, for the Consolidated Canal Company, Mesa, Arizona. The water is taken from the Salt river and carried by 48-inch feed pipe across the Utah canal to a pair of 21-inch cylinder gate Victor Turbines on horizontal shaft, developing 400 h. p. under 40 feet head. One end of shaft is connected by friction clutch to a 200 h. p. dynamo which furnishes light and power for the town of Mesa, Arizona. The other end of the shaft is connected to a pumping plant for irrigating purposes. This novel plant is suggestive of further possibilities in this line.

POULTRY RAISING.

The raising of poultry for profit has long since passed the point where chance was a prime element. In these days the successful man or woman is the one who is willing to adopt improved methods. The old "Biddy," hen, has given way to the incubator, which can hatch a hundred or more eggs as easily as a dozen. The Reliable incubator has been on the market for many years, and each succeeding year has seen it improved in every particular. It gives satisfaction wherever used, because it fulfills all the claims that are made for it.

The manufacturers of these incubators have recently issued a large and handsome catalogue, which, in addition to a full description of the incubators, gives much valuable information in regard to poultry

raising. This catalogue will be mailed, post-paid, if you mention THE IRRIGATION AGE, by the Reliable Incubator and Brooder Company, of Quincy, Ill., upon receipt of ten cents in stamps or silver.

THE AERMOTOR.

It is estimated that the Aermotor Company is now manufacturing fully one-half of the total output of windmills in the United States. The remarkable progress which this concern has made under the able management of its president, Mr. L. W. Noyes, since it was organized not many years ago, has engendered a feeling of envy among the manufacturers of other windmills, and in several instances the methods of the Aermotor people have been copied closely. This jealousy has even extended to the manufacturers of a windmill similar to the Aermotor, but as the imitation possesses neither the strength nor the wearing qualities of the original, there is little expectation of its being introduced except among unintelligent people. A complete catalogue describing the Aermotor and giving much valuable information in regard to irrigation, such as the building of reservoirs and ditches, has recently been issued, and if THE IRRIGATION AGE is mentioned a copy will be sent free on application.

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The easy way of going is a relic of the past,
And now it's hurry! Hurry up! Now, hurry!
Hurry fast!

It's very sure if you don't run the other fellow
will,

And so you want to hurry, and then hurry harder
still.

If some one's bound to beat you, you can pass
him in a wink

If you but keep a hurry on, and never stop to
think.

There may be time to catch your breath when
you have caught your car;

But sixty seconds to the minute's all of them
there are;

There are but sixty minutes out of every hour
of those,

And when you figure very fast, it's awful how
it goes!

And don't forget you've got to get there mighty
quick, because

You've got to get away again, and snatch it from
the jaws.

Whose jaws they are don't cut no ice, nor what
you're going to snatch;

You can't be too particular in such a shooting
match.

You needn't stop to fix your feet and try to walk
a crack,

For though it's tough a-getting there, it's tough-
er getting back.

There's little time to linger on the greeny, grassy
lawn,

When long before you've gotten there you ought
to then be gone.

So keep a-humping, bumping, now, and jolly
right along,

With here a hurry! there a hurry! then a hurry!
strong.

If you but keep your hurry on, and hurry, hurry
fast,

It's ten to one you're on the run, and may get
back at last.

—W. D. Ellwanger in New York Sun.

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"	20	2	1	8 " 16	7	2	200	60 00	75 00
"	25	$2\frac{1}{2}$	1	10 " 24	11	2	225	66 00	81 00
"	30	3	$1\frac{1}{4}$	12 " 35	15	2	250	75 00	90 00
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THE IRRIGATION AGE.

VOL. IX.

CHICAGO, MAY, 1896.

NO. 5.

PUMP IRRIGATION ON THE PLAINS.

BY H. V. HINCKLEY.

(Consulting Irrigation Engineer, Topeka, Kansas.)

THE only limit to the profitable development of the billion acres embraced in the "Great American Desert" is the extent of the available water supply. The mountains and the plains afford hydrographic conditions which are entirely dissimilar. The "little farm well tilled" and watered, when compared with the bonanza wheat farming of recent years, is a step toward agricultural independence. The community in which the individual secures water from an unlimited supply under his own land is free from the control of bonded syndicates.

It is not within the province of this article to discover the various causes of financial embarrassment which have come upon many of the landed and bonded canal and water supply systems in, or originating in the mountains. The most practicable plan for the conservation of mountain waters for use in mountain parks, or on the plains in immediate proximity to the mountains, is that of mountain or cañon reservoirs with open channel or pipe conveyors, and failures of such systems to pay the anticipated revenues have not been due to the fact that they have been so constructed. Upon the prairie plains, however, natural reservoir sites or favorable dam sites are scarce, evaporation reaches high maxima and artificial reservoir storage of surface run-off is, in general, impracticable.

The plains streams are generally intermittent and are often dry during the season when water is most needed for plant growth. Where the plains break geologically into high rolling lands, as in Eastern Kansas and Nebraska, storage in a small way is practicable (that is to say, in reser-

voirs smaller by far than those which are or would be built in the mountains) as by a dam, across a ravine, holding back a lake of say ten to 100 acres. Some of the valleys within these broken plains and a large area of the prairies have beneath them a never-failing water supply, moving constantly but slowly under the influence of gravity toward the sea or toward natural surface channels in which it may flow oceanward or be evaporated. This underflow is replenished by rainfall sinking through the sandy soils of the plains in general and, in the valleys, by the downward lateral flow, from natural channels, of storm waters or mountain snow waters.

It is generally conceded that to dam a plains river, like the Platte or the Arkansas, having a practically bottomless bed of sand, and to thereby hold back and divert the floods either into service canals or into side-hill or other reservoirs, is impracticable. Numerous canals have been built for the diversion from these rivers, during the flood season, of the portions of the flood represented by the carrying capacity of such canals. The general result is an annual washout of cheaply constructed head-works, an unseasonable, unreliable and, consequently, unsatisfactory service to patrons.

The writer will not say that the construction of canals upon the plains proper is in no case justifiable. Local conditions may be, and in places are, such that a canal may be an unqualified success, and such that no other service will fit them as well as that of a canal system, but the future water supply for plains irrigation will not come from the surface flow of rivers.

MONEY WASTED IN CANALS.

One of the Western Kansas canals represents over a million dollars of wasted capital, which was invested with a lack of knowledge regarding the hydrography of the region. Failing in attempts to maintain a dam for the diversion of the floods (into a canal having a capacity of only a small per cent of the flood flow) its company built a long, easy diversion dike. This failing, an attempt was made to tap the underflow by an open channel extending up stream, with lighter grade than Nature gave the river. Other companies are even now following suit, and failure awaits most of them.

The development of underground water supplies is properly a problem of engineering, not of financing nor politics, and the man who attempts to develop the underflow by guess would go to law without a lawyer, and he must expect to be fined for contempt in Nature's court. Probably two thousand individuals in Western Kansas have erected pumping plants of various styles and capacities within a few years past. So far as known the rate of progress is illustrated by the following comparison of the number of plants erected: 1891, 18; 1892, 33; 1893, 55; 1894, 224; 1895, 1,241. The State Board of Irrigation reports that six of these men pronounce pump irrigation a failure. Is this strange? Irrigation is a new feature of agriculture on the plains. It has taken the writer over two years of investigation and study to get even a fair idea as to water duty on the plains, the cost and methods of underflow development, the relative cost of pumping by various powers and other kindred problems, all of which concern *every* irrigator, be his farm large or small. It is wonderful, then, if only a fraction of one per cent of the farmers who have attempted pump irrigation have made mistakes sufficient to cause them to pronounce it a failure.

COMMON ERRORS.

It is so easy for a man to put in a pump for raising two thousand gallons a minute from a well that can only supply five hundred gallons a minute, and whose capacity could have been told before erecting the pump; so easy for a man to assume that with an average annual rainfall of twenty inches he will need but a very little water, forgetting or not knowing that it is the minimum of two inches in the first six months of the

year, or the minimum of five inches per annum, upon which his needs should be based; so easy for him to find in manufacturer's catalogues the indicated and actual H. P., and so think he has made all necessary allowance for friction when he buys the necessary "A. H. P." computed from the water lift; so easy for him to base his windmill computations on a fifteen-mile wind given in catalogues, when the average is but eleven, to forget the law of squares and to forget that the wind blows lightest when he needs the most water.

A FEW INSTANCES.

Let us now look at a few fair representative cases of what is being done in one season in a section of country that has been nearly depopulated on account of insufficient rainfall to produce crops.

Eugene Tilleux, Tribune, Greeley Co., Kansas, uses an eight-foot mill; well 130 feet deep to water. Planted one acre of garden vegetables; three-quarters of the area was a total loss. Mill was only good for a quarter acre, and furnished not over six inches in depth of water during the season to that quarter. Besides all vegetables needed for family use, received from sale of surplus ninety dollars, which paid for the pumping outfit.

I. L. Diesem, Garden City, Finney Co., Kansas. Fourteen-foot mill; seventeen feet to water. Cost of plant, including reservoir, \$200. Irrigates twelve acres. Two acres sweet potatoes, 303 bushels; four-tenths acre onions, 400 bushels; half acre sugar-beets, 128 bushels, etc. "Have made a living this year and paid off a three hundred dollar mortgage."

J. M. Cramblett, Kinsley, Edwards Co., Kansas. Twenty-eight feet to water. Irrigates one-half acre with small windmill. Yield: 160 bushels of tomatoes, sold for \$40; four tons of cabbage, sold for \$160. Cabbage yielded at the rate of \$640 per acre. Onions and other vegetables for family use not measured.

V. Q. Billings, Kinsley, Edwards Co., Kansas. Twelve-foot mill; cost of plant \$150. Put in too late; could not irrigate till June, when crop had begun to suffer. Had several mishaps with mill and reservoir, but still sold from one and a quarter acres, potatoes, \$300; cabbage, \$100, besides family supply.

N. O. Waymire, Garfield-on-the-Arkansas, Pawnee Co., Kansas. Reservoir is filled with an eight-foot steel mill located over 200 feet away. Cylinder is a 4x12 brass-lined Morris Perfection with 7½ inch stroke. Sheet water is found at a depth of ten feet, and is drawn through a two-inch sand point. Pump is hand-made, of two-inch pipe, with large air chamber and stuffing box. Conducting pipe is 1½ inch laid on the ground, and goes over the embankment with 45° elbows, forming a siphon. This makes the lift thirteen to 18 feet, according to amount of water in reservoir. Ground irrigated in 1895, with reservoir shown, was one acre subsoiled, and ¼ acre not subsoiled.

if he nets \$12 to \$15 an acre above expenses. He who grows alfalfa and feeds it nets \$20 to \$50 an acre. He who has a handy market for vegetables or has a bearing orchard or vineyard often nets \$100 to \$200 an acre and occasionally very much higher figures are given.

THE MOGUL WINDMILL.

As the price paid for a pair of pants frequently depends upon the amount which the purchaser has to spend, regardless of the real economy of the purchase, so, many farmers on the plains who have trusted for years in the possibility of an increasing and more reliable rainfall, only to be disappointed, and who have lost crop after crop, and seed after seed, have been obliged to economize in the extreme in pumping plant investments and, in the absence of credit, to buy or make what they could. This has resulted in the experimental and limited use of the Mogul. This machine is generally set for a north or south wind, working equally well with either, and diminishing in power as wind veers toward east or west.

A Mogul 12 feet in diameter, 14 long, with 8 fans 2 x 14 feet, will irrigate from 1 to 2 acres with 20 feet lift. The cost, if built new and all work paid for, is from \$100 to \$200. If made by the farmer, of old stuff on hand, the cash outlay may be as low as \$25. This machine is sometimes made with fans of one board only, say 1 x 10 feet, for irrigating small garden.

D. M. Frost, President State Board of Irrigation, has on his farm at Garden City a Mogul, diameter 18 feet, shaft 12 feet, fans 3 x 10 feet. Cost \$175. Irrigates 3 acres in summer or six during the year. Also a steel tower mill, diameter 14 feet, cost \$300. Irrigates 10 acres in summer or 20 during the year. Water lift 15 feet.



PERSIAN WHEEL.
From 12th Annual Report U. S. Geological Survey,
Part II, Irrigation.

EGYPTIAN TYMPANUM.

Reservoir of 1896 is 50 feet on outside at base and five feet high. It is over two feet below the surface, will hold, when full, seven feet of water, and has nearly twice the capacity of one shown in engraving. Crops grown in 1895 were largely experimental but were satisfactory.

F. L. Richter, Garden City, Finney Co., Kansas. Seventy acres alfalfa and orchard, income seven thousand dollars.

A. L. Parson, same address. Five acres fruit and produce, six hundred dollars.

E. E. Frizell, Larned, Pawnee Co., Kansas. Reservoir 130 feet in diameter, banks eight feet high. Can draw out of it (at one time) over a half-million gallons, or seven acres three inches deep. Two fourteen-foot steel mills on thirty-foot towers. Ten-inch cylinders. Twenty-six-foot lift. Fill reservoir in three days on an average. Have successfully irrigated 25 acres of orchard, 20 of alfalfa, 13 of potatoes, 16 of beans, cabbage and onions. Spanish onions yield 400 to 1000 bushels per acre.*

The mistakes that have been made—the disappointments resulting from less acreages being irrigable by given plants than their owners had anticipated—have been more than balanced by the phenomenal yields under reliable water supply and thorough cultivation. The mills above mentioned are the common form of radial fan windmills on towers. Hundreds of similar cases could be cited. Suffice in a general way to say that windmills of ten to sixteen feet diameter (mostly steel mills) on towers 30 to 40 feet high are successfully irrigating from 6 to twenty acres with 20-foot lift, or 1 to 3 acres with 150 foot lift, and an investment of \$150 to \$300 is enabling the farmer to realize generally from \$20 to \$100 per acre per annum. No definite statement can be made as to average results obtainable from such investments. Intelligence and muscle are as essential as water. The man who still insists on growing wheat and corn does well

*See illustration of Mr. Frizell's reservoir in April number of THE AGE.

"MOGUL" WINDMILL.
Pumping into a Reservoir at Garden City, Kansas.

The Mogul is less reliable than the tower mill. The direction of the wind is not controlled by the irrigator and the wind is not as strong at the surface of the ground as it is 30 or 40 feet in the air.

From seventy to a hundred tower mills can be counted from the train as one passes Garden City. The windmill is the popular pumping machine; that is to say there are, on the plains, several times as many windmills on towers as there are of all other kinds of pumping powers combined because wind *per se* is cheap. Con-

trary to popular opinion, however, cheap wind does not necessarily furnish the cheapest power.

OTHER FORMS OF POWER.

Following in order of power, after the Mogul and tower windmills come the gasoline engines, driving centrifugal or auger pumps for low lifts from creeks or open wells; rotary pumps (positive) for higher lifts, or reciprocal (cylinder) pumps for very high lifts, as at the Goodland state pumping station. These plants, complete,

"DEFENDER" WINDMILL.
A sample of what inventive (?) genius is doing on the plains.

F. W. RICHTER'S PUMPING PLANT, GARDEN CITY, KANSAS.

Three ten-inch cylinder pumps being operated by one 16-foot Aermotor. Engraving shows frame of foot of tower.

cost from \$500 to \$1500 or more, though the average cost is more nearly the lower than the higher figure.

Then come the compound duplex (or high duty) steam pumping engines of usual water-works type, pumping from reservoirs or rivers. These large steam plants being expensive are not in general use, parties who could well afford the investment preferring to await the experience of others with similar plants.

A STEAM PUMPING PLANT.

Geo. M. Munger, of Eureka, Greenwood Co., Kansas, has 500 acres of orchard. He built an earth dam behind which he impounds 700 acre feet of water. He proposes to increase the storage capacity to 1600 acre feet.

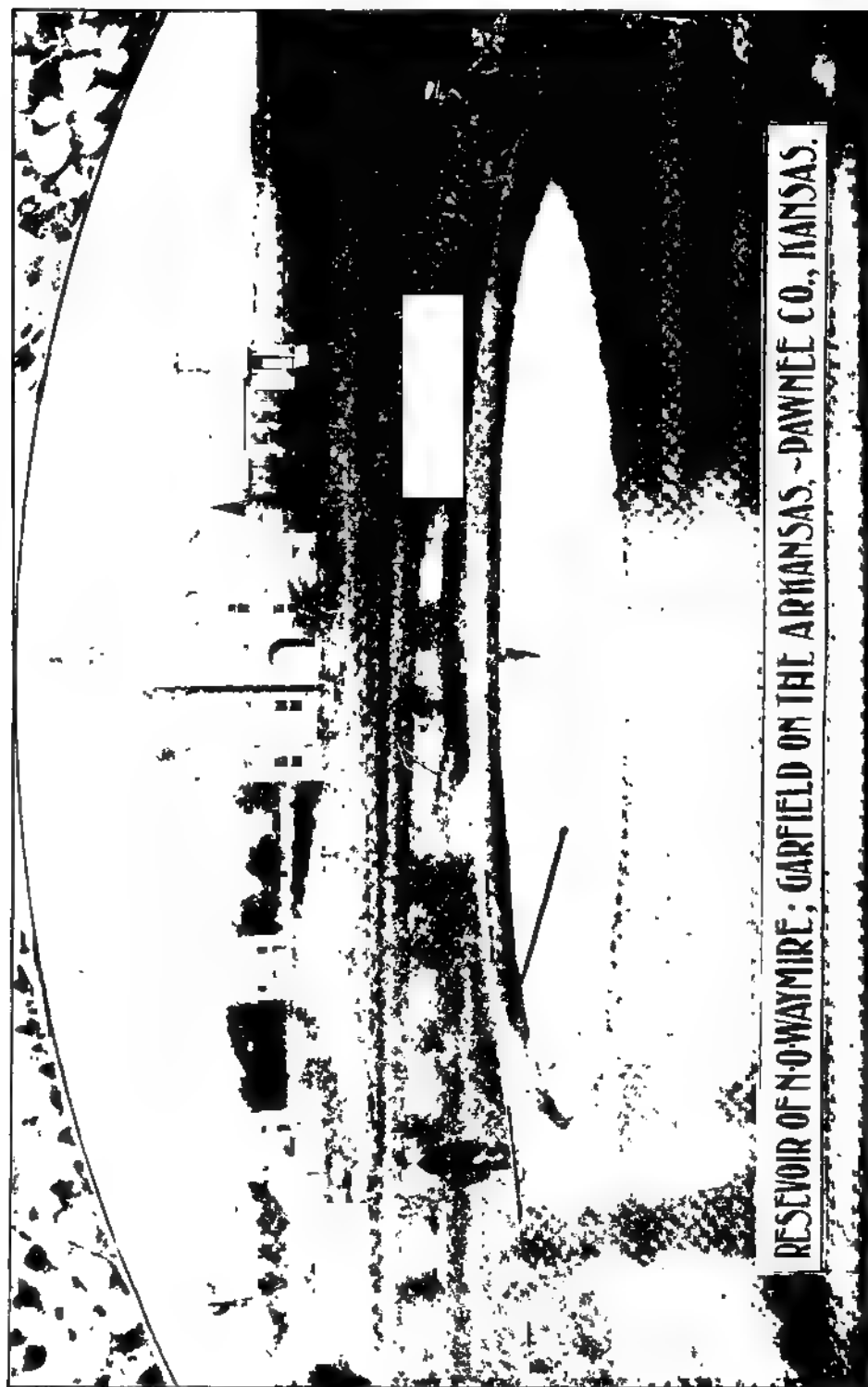
He has two boilers, each 35 H. P. compound duplex pumps, capable of lifting

four million gallons a day against a lift of 49 feet above the pumps. Cost of plant to date something over \$15,000. Estimated cost of enlarged plant \$25,000. He says he prefers not to give publicity to his figures as to gross value of crop, profits from water investment, etc., as "these items vary so widely in practice that it would not do to publish them." However, he said to the State Board of Horticulture, very recently, "The question of whether or not it pays is the vital one to be considered. Should a man obtain by irrigation 100 bushels of corn per acre and get 15 or 20 cents per bushel for it he would not be making headway rapidly, but if a man has a bearing orchard that is yielding an occasional crop of from 50 to 100 bushels per acre of which one-half to three fourths must be classed as seconds or culls, and if by irrigating that orchard

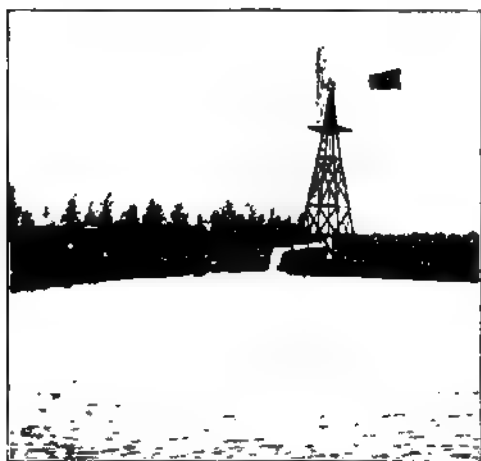


STATE PUMPING PLANT AT GOODLAND, KANSAS.

10 Actual H. P. Gasoline Engine, operating a 5 1/2-inch cylinder with 36-inch stroke, in a 6-inch well, 170 feet deep and raising from the underflow 6,000 gallons per hour.



RESEVOIR OF N-OWAYMIRE; GARFIELD ON THE ARKANSAS. -DAWNEE CO., KANSAS.



A TYPICAL PRAIRIE IRRIGATION PLANT.
D. M. Frost, Garden City.

he can increase the crop to three times the quantity and have it all grade fancy, it is easy to see that, at any prices for fruits that have been known to prevail, he could afford to spend a very considerable sum per acre to install an irrigation plant.

"Then if, in place of an occasional crop, the irrigation will give him regular annual crops of this class, it requires no book-keeping to discover that it is profitable."

Gasoline has taken a notion to advance since it has come into considerable use as a pumping power. Coal sells at from four to six dollars on the plains and

the need of a cheap, reliable power for pumping offers inventive genius a prolific field. The "Defender" and the "Mogul" do not supply the need.

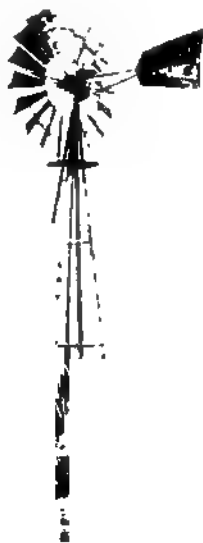
The wind is lightest and the sun strongest during the driest months. Who will give us a practical helimotor and reap the reward that awaits him?

THE AVERAGE RETURN PER ACRE.

Pump irrigation, or anything else, is a failure if it does not pay. The following table gives returns from certain crops as reported by quite a number of prominent irrigators on the Western Kansas plains. Each item, being the *average* of those reported to the writer, would seem to be entirely within the reach of any intelligent and industrious irrigation farmer.

Crop.	Annual Returns—Dollars Per Acre.		
	Average Bottom Land Not Irrigated	Average Irrigated	Best Results Irrigated (Average)
Alfalfa Hay and Seed.	21	36	61
Alfalfa Hay only..	14	29	36
Corn.....	5	11	24
Wheat.....	7	18	29
Potatoes.....	25	137	250
Sweet Potatoes.....	25	173	338
Onions.....	50	275	550
Small Fruits.....	100	625	1,100
Orchards.....	50	537	1,000

Allowing for exaggerations or over-enthusiasm of the honest farmers furnish-



PUMPING PLANT OF PRESTON WYCKOFF, BOME, KANSAS

ing the data from which this table is made there is still enough margin to justify the erection of pumping plants when water is at any depth at which it is ordinarily found in abundance.

Good judgment dictates in general the cultivation of various crops on the same farm—for example early potatoes and late cabbage—thus making a given monthly supply of water do double duty. In favorable soils deep plowing and winter irrigation (storing the water in the sub-soils) still further increases the duty so that all the year irrigation may be made to cover three times the acreage of ninety days' summer surface watering.

In general the larger pumping plants of either class are the more economical for reasons which it seems not necessary to explain.

By reason generally of a saving in first cost other combinations are in occasional use: a second-hand steam thresher engine belted to centrifugal pump, animal power geared to endless chain or belt of elevator buckets or board buckets lifting in box spouts.

The whole matter of pumping water for irrigation is so new to our people that they often adopt make-shift arrangements till they can see with their own eyes what a little water does for them. How many New York farmers pay \$10 or \$20 an acre annually for fertilizers and then reap, on an average, only a half or two-thirds of a maximum crop because of a partial drought at some time during the growing period. Unreliable water by canals has been costing the average irrigator of the United States almost exactly one dollar a year per acre. Reliable water by pumps, properly planned, costs from one to three dollars in the valleys proper and as high as five or even ten dollars on the higher lands—including interest.

Where is the fruit or vegetable grower who does not, nearly every year, realize that he could well afford to pay five dollars an acre or even more, rather than to have suffered from the deficiency of water that visited him at some time during the growing season?

(To be continued.)

THE ART OF IRRIGATION.

CHAPTER XII. IRRIGATING BY FLOODING (Continued).

By T. S. VAN DYKE.

THE size of the checks to contain the water in irrigation by flooding will also depend upon the head of water at your service.

Suppose you have two cubic feet a second, or one hundred miner's inches for ten acres. This is head enough for most any orchard work on almost any soil worth cultivating at all, and though for alfalfa much more may be used, it is quite ample if no more can be had. Suppose the checks are twenty feet square, which would give them an area of four hundred square feet. It would then take two cubic feet a second but two hundred seconds to fill one a foot deep. But you rarely want more than the equivalent of three inches of rain at a time, or one-fourth of an acre foot. This would fill the check in fifty seconds. A line of checks to watch and let the water from one to the other as fast as filled and have no breaking away of the

water will keep you and two other average men hopping about pretty lively. And the chances are you will find any kind of waterproof boots too slow as compared with bare legs. There is no room for style in this work. It is very strict business, and often there is a very short time in which to do it. If you want to hire less help, you will make the checks larger. But here you may be limited by the nature of the crop as well as by the slope of the land. If it is an orchard it will probably be more convenient to have the ridges in the center between the trees. It is impossible to lay down any rule. The right thing is a see-saw between several extremes. In some cases it will pay to use a smaller head to avoid making too large checks, and on the contrary you may have to make them large because you are limited to so short a run that you have to use a very large head to get over the ground

within the time allowed you to run the water.

It is best to decide at the outset how much water you will put on a tract in a given time. Two cubic feet a second will cover ten acres to an average depth of three inches in about fifteen hours. On account of mistakes in printing you had better figure over for yourself all such matters, and not rely on printed figures anywhere. But you will rarely need to put on even that amount of water at once. A depth of two inches, which can be put on in about ten hours, is equal to three inches of rain, as it generally comes, and this is enough at a time for almost anything, unless the ground is very dry, or it is to be a long time before you can get water again. On a square ten-acre tract there will be about eleven hundred checks of twenty feet square, or thirty-three rows thirty-three checks long. Ten hours' run of two cubic feet a second, giving the equivalent of two inches in depth, would be six hundred minutes or but a trifle over half a minute to a check. But if as small as twenty feet, you do not turn the whole head into one check, but take them in tiers of several. A tier of six would thus give you a little over three minutes to a check. But, then, time is lost in dividing the stream and letting it from one check to the next as soon as one is filled. On the whole it is lively work, but when everything is well arranged, flooding beats the capricious clouds so much that you readily forgive it for keeping you up sometimes in the middle of the night while the man who has small streams trickling down small furrows is serenely snoring.

Checks are generally so arranged that when one is full, or nearly so, the water flows from it to the next one. Sometimes this flow will need help, and where the land is to be broken up again after irrigating they had better be made sometimes so that one will not feed the next one as there is danger of the bank cutting out too soon. How strong or high to make the bank will depend much upon the nature of the soil as well as of the crop. Where the soil is very light it is best to make the ridge so that you have to break it. This is not much of a task as you have to be there anyhow, and if the water gets away from you, a dozen men may not stop it before it has done mischief that will cost you much more labor than opening the checks. But

if the ground is not to be broken up after wetting, as in alfalfa fields, then the lower ridge may sometimes be made so as to feed the next check, and so on to the end of the line, unless you feed each from the ditch direct, which is often done where the checks are large. But it is safer to cut the checks so as to discharge all water quickly. In any case the ridges, if permanent, must be made very strong and very broad at the base. When the roots have taken possession of the top soil a very light stand will prevent cutting of the soil and accidental breaking of the check. All trouble is, however, best avoided by a wooden gate large enough to feed properly from check to check, and it can readily be seen so as not to be in the way of driving machinery over the land. With these properly set, a breach of a well-made check is almost impossible.

MAKING THE CHECKS.

A common way of making the checks is by throwing up ridges with a plow or scraper. On some soils two plow furrows running in opposite directions, so as to throw the sod to the center, are enough for almost all temporary checks. This, of course, means very level ground, and it may be so nearly level that it is not necessary to throw the two furrows together. And some ground is so near a perfect level that one furrow will often do. Stubble is often wet in this way to prepare it for plowing, and by making the furrows only a few feet apart, land quite sloping may be well wet. This is a good enough way to prepare some ground for plowing. But in all cases where the ground is already so loose that a scraper may be used, it is best to throw up a good ridge, for with that a larger amount of water may be put into the ground with much less danger of uneven wetting.

What is probably the best scraper for this purpose can be made by any one. It is called a "ridger" and is nothing but a sled with solid board runners. These converge at one end and diverge at the other according to the ease with which the soil will scrape and the size of the ridge you are to make. One five feet long with the opening between the runners a foot or so wide at one end and three at the other will make checks strong enough on most soils to hold water five inches deep if the soil is in good cultivation to scrape. But the size of the ridger will vary with soils

and other things, so that no general rule can be given.

If the ridger is not heavy enough with a man on it, it may be weighted with sacks of earth. When dragged over loose earth with the large opening forward, this will throw the earth to a ridge in the center behind. On rebellious ground, and often on any ground, it is advisable to have two ridgers, one larger than the other running ahead to gather earth, the other attached immediately behind to concentrate it. But to work well, this, or any other form of scraper, must have the ground in fair condition from harrowing

from either side there will be openings to be filled with the hoe. This is not as much of a task as it would seem, and for some work you may so arrange the lines according to the slope of the ground that you can use those places to let the water from one check into the one below it and thus not have to fill it so completely.

TURNING IN THE WATER.

When all is ready, the head of water is turned in and divided among as many tiers of checks as can be comfortably handled at a time. If the stream is too large for the number of checks, it will

VERY FINE FLOODING WORK

Line of checks filled and head of water in lateral passing on to next line. Water all of uniform depth with checks filled and emptied in less than three hours. Checks made with "ridger."

or plowing, and sometimes both. If the ground is hard or tough the plow furrows above described are about the best made available. In all cases heavy clods and big flakes will interfere with your work by letting the water through the ridges if too plenty.

Where the checks are to be permanent, as for alfalfa, they may be made well enough on many soils with the ridger. More care must of course be taken, and generally they should be rolled or dragged down into shape. A very effective scraper called the "Fresno scraper" is used in the large alfalfa fields for making these ridges, and does very perfect and rapid work. But for ordinary fields it is not necessary to buy any machinery.

When made with a ridger at each junction of a ridge with another crossing it

keep you jumping too rapidly to keep it from breaking away. If you have too many for it to fill at a time then you will do too much leaning on the hoe, and, as you generally have to hire help at this time if working much ground, you want to save time as much as anything. You will soon find the right medium by trial. Also when and in how many places to break a check so as to let the water quickly into the next one, and also how to build the lowest place in a ridge so that the water will flow out when you want it to and not before. No rules can be given for this work that are not subject to so many exceptions as to be almost worthless.

The time required to get the water over a ten-acre tract with a head of two cubic feet a second or one hundred miners' inches under four-inch pressure will vary

from six to fifteen hours, according to the nature of the soil and the necessity of rushing the water over it rapidly, and also according to the number of the checks and the freedom of passage for the water through them and out of them. With larger heads you can do it in less time but will need more help, and vice versa. But slow flooding is generally bad, especially where the water stands deep, and generally all that remains in a check after doing its work is a detriment and no longer a benefit.

Sometimes checks are fed from a main at the upper side exactly as in orchard work with fine furrows. And where the checks are numerous and small this is often best, dividing the head so as to take the checks in blocks or tiers. Often it may be better to have the ditch run through the center feeding to right and left. The trouble in such case is to empty the checks fast enough without wasting the water. Where one feeds another there is little waste. The ditch must in all cases be high enough to ensure rapid and certain feed of water.

The time required to soak the ground will also vary greatly with the nature of the soil. If the checks are so made that they do not break and let out more water than you intend, the soil will be well soaked in two or three hours, and often less time after the check is covered on the bottom. If it takes much longer than this, it is pretty strong evidence that the texture of the soil is so close that fine furrows would do better for all orchard work. For in such case you are quite certain to be troubled with the soil baking too much and making it difficult to cultivate and keep the soil open with cultivation. There is also danger of scalding tender stuff in hot weather.

As the upper checks feed the lower ones and are thus full for a longer time in a long series, one would suppose that the upper side of the field will be much wetter than the lower. The same would be expected from fine furrow work. But in general no difference can be seen if the work has been well done. And it is not difficult to arrange the breaking of the checks in such way that the water will remain longer in those at the lower side. But you need not at first trouble yourself with such points, but concentrate all your talents on getting the water over the whole

as quickly as possible without having it stand too deep or too long in any one place. When once you have mastered this you will find all the rest easy enough. And if you have laid out the slope right and made the checks with care, and have plenty of help to handle the rush of water when it comes, you will find no trouble even with this.

PROTECT THE TREES AND VEGETABLES.

Flooding may be used for all sorts of vegetation. But where possible, the stalk or stem of everything should be protected from contact with the water. In the case of trees it is easy to leave a little mound about the trunk so that there is no excuse for the water touching it. But with many vegetables and small tender stuff it is generally impossible to do this at any reasonable cost. If the plants cannot in such case be set up on a little ridge above the water it should be spread over the whole in a thin sheet with the greatest speed possible. And if possible it should be done in the afternoon or evening so that the sun cannot strike the stem until it and the ground around it are comparatively dry. Plants differ much in the ability to endure the baking of the ground around the stem and the scalding of the stem from having the hot sun strike it while wet. Young melons, for instance, are quickly hurt, while young radishes seem unaffected. As a rule the evil is exaggerated by many. Not much harm will be done anything if the water is not allowed to stay around it too long, or too hot a sun allowed to strike the stem too soon after the water is taken off. In cool, cloudy weather there is little danger. As it would take you years to find out just what different things will bear in this way it is best not to risk it, but keep the water away wherever it does not cost too much in labor or money to do so.

ALFALFA AND GRAIN.

Many things such as alfalfa or grain that will stand considerable water about the stem and baking of the ground when old will not endure it when young. Certain loss will follow neglect on such things. The remedy is often simple where you can get a long run of a large head of water; and, if you cannot, you have little business trying to raise such things. It is to wet the ground so thoroughly before planting that the plants will need no more

water until old enough to shade the ground and become tough enough to endure considerable baking and scalding. The soil should be well soaked before plowing even if it takes two or more floodings to do it. Then, when in condition, it should be so well plowed and harrowed that it will retain moisture and remain mellow. Then your stuff can grow two or even three months without more irrigation and in many places will make a crop of grain without any more. But to flood it just after it is up is always to hurt it, and often to ruin most of the stand, however good it may be.

The great problem in flooding is how to make a number of checks feed each other without having the water stand too long in each, or having it run so fast through the upper ones as to cut or otherwise damage anything in it, and at the same time to use up the whole head in the series so as to have little or none to waste at the lower end.

If checks do not feed each other, then you have the expense of more laterals and gates, and more care in watching each check so as to get in just enough water to soak away quickly, and no more. If you have to have a waste ditch at the lower end to empty the check completely and see that it is done, then you might as well have one feed another at once. If you can run just the right amount into a check at once and be sure that it will soak away quickly enough to avoid scalding, or such puddling as is sure to result in bad bak-

ing, even if no sun strikes it, then, everything else being equal, it is best not to have one check feed another. But it often costs more in time and labor.

Suppose, then, you are feeding a line of ten checks, one from the other. You want to have each soak an average of two inches in depth. If you let twenty inches in depth into the first one, with the view of letting it all out when it has settled down two inches, you may press down and puddle the soil too much in a very short time. Many soils, such as a fine granite soil, will rarely stand this, and in some such a depth of water will by puddling stop the soaking instead of hastening it.

You must then start with less water and run in more after you have cut the check to let it into the next one. But this involves the danger of keeping deep water too long in the first one, or else cutting the soil or injuring vegetation by running the stream over the bottom of it after it is emptied. And whichever way you try to avoid these troubles you may find yourself at the end with a large amount of waste on hand which should have gone in the ground. For you want to learn at the outset that waste hardly ever pays.

There is no royal road out of these difficulties, because each case must be decided on its own peculiar state of facts. But if you bear in mind the main principles you will soon find your way out of the woods with a little patience.

(To be continued.)

FLOODING WITH TEMPORARY CHECKS.

Checks made with ridger. Checks just emptied showing ground puddled where water stood too deep and too long. For orchard work to be followed by cultivation this does little harm if not too great, but it would greatly injure young grain or tender vegetables and destroy many of the plants.

WATER SUPPLIES FOR IRRIGATION.

CHAPTER V. STORAGE RESERVOIRS AND DAM SITES.

BY F. C. FINKLE, C. E.

MANY of the large and important irrigation systems of the world derive their supply of water from storage or impounding reservoirs.

A storage reservoir is the artificial lake bed or basin formed by closing the outlet or outlets to a valley or canyon. After the outlets are closed by means of artificial barriers called dams, water entering the valley is retained in the basin and accumulates, thus forming an artificial lake from which water can be drawn as desired. The object of storage reservoirs therefore becomes apparent, the water entering the basin at times of the year when it is not needed for irrigation, being conserved to be drawn off and used at other times when irrigation is practiced.

A storage reservoir for developing a water supply for irrigation purposes is expedient and useful only in regions where such a large proportion of the precipitation takes place during the proportion of the year, when no irrigation is practiced, as to render the natural water supply inadequate for the purpose of irrigating when irrigation is necessary.

There are certain requirements making a storage reservoir practicable, or at times even possible. These we will now enumerate and proceed to discuss in the natural order. They are as follows:

- (1.) A suitable valley or basin.
- (2.) A favorable dam site.
- (3.) An adequate water-shed.
- (4.) Proximity to irrigable lands.

It is always necessary that these requirements be all combined in such a degree as not to have the failure of an enterprise due to the absence of either one of them. At the same time it is not to be expected that they are all to be found present in a perfect state, nor even in a relative state of perfection for that matter.

The first and most necessary essential to constitute a valley or basin suitable for storage purposes is sufficient area. As will be seen later on the cost of building dams is always great so that it is necessary to have a considerable area which can be

flooded in order to make an undertaking of water storage profitable.

Of course no fixed area can be stated as a minimum for the reason that the figure must correspond to the amount of investment required for dams. Extreme cases are sometimes encountered when small tracts of only 300 or 400 acres can be profitably utilized as storage reservoirs. This is only the case, however, when the other requirements are developed in such a marked degree as to render the cost of constructing a dam very small and the average depth of water nearly if not quite equal to the height of the dam. The locality also tends to influence the question of whether a reservoir site of limited area can be profitably improved or not. The value of water varies so much in different localities that an enterprise, which would prove profitable in one place, might possess no value at all in another locality.

Next to sufficient area the most important requirement in a reservoir site is that the slope or pitch of the land included in it be light, uniform and gradual. Abrupt descent toward the dam site or steep side slopes from the middle of a valley toward either side often render it unfit for a reservoir site although it be of very large area. In order to make the flooding of a considerable area possible, where the slope is abrupt, a very high dam must be constructed, and the cost of dams increases so rapidly, in proportion to their height, as to condemn such propositions from a financial point of view.

The value of water for irrigation purposes in the particular locality in question is also an important factor to be carefully considered as well in this connection as has already been suggested in connection with the question of area. In localities where water is very valuable a grade of seventy-five feet per mile in the reservoir site may not be objectionable, while in other localities where water is cheap a grade of twenty-five feet per mile may be sufficient to condemn a storage project.

Should the soil in a proposed reservoir

site be of such a loose and porous character as to not be capable of retaining water, but such as would allow it to sink and escape too readily from the reservoir, that would be a fatal objection. In all cases under consideration, thorough examinations should be made to determine the condition in this particular.

Another matter of importance is the liability of the reservoir to fill up with materials having a specific gravity greater than water. Such materials are usually brought down from above by heavy floods, and the checking of the current when the water charged with them reaches the reservoir causes them to settle. This objection can sometimes be overcome by intercepting the materials before they reach the reservoir site or by sluicing them out after they are in. The former method is practicable when the materials are coarse, provided that a suitable place can be found in which to intercept them, and the latter when they consist of fine sand or soil and an opportunity exists for constructing scour or sluice gates for removing them. Materials having a less specific gravity than water cause no difficulty as they will float on the surface and escape over the waste weir.

REQUIREMENTS FOR A DAM SITE.

The conditions which make a site desirable for the construction of a dam are a narrow passage to be closed, a reasonable depth to material suitable for a foundation, good opportunity for draining the foundation, and proximity of suitable materials for constructing the dam.

All of these things materially influence the cost of a dam and in this way affect the feasibility of a project. Before any recommendation of a storage project is made, surveys and borings to determine the exact length of dam required, the depth to a foundation and the amount of water to be handled in draining the foundation should be completed. Then the class of materials required for a dam can be settled, the data already obtained enabling us to decide what type of dam to build. Next the point from which the materials for construction are to come ought to be ascertained, after which their cost can be accurately estimated.

Finally comes the estimate of the total cost of a dam based on all of the above by taking into account the contents of the foun-

dation and section of the dam, the amount and cost of handling the material to be excavated for the foundation and the cost of cuts, tunnels or pumping water for drainage, together with the cost of finishings, gate tower, other equipments, superintendence and other incidental expenses.

SUFFICIENCY OF WATER-SHED.

In order to derive the greatest profit from a storage reservoir its tributary water-shed should be capable of filling it at least once every year.

If the water-shed is limited so that the reservoir cannot with certainty be depended on to fill every year, a portion of the water has to be carried over each year, so as to ensure an ample supply for the ensuing year. In a case of this kind a large reservoir may lose a very considerable portion of its value, as the duty which it can perform will depend entirely upon how much of the reservoir will fill in years of minimum precipitation.

Thus it will appear that a large reservoir site and an easy dam site are not the only things to be sought, but that an adequate water-shed for supplying it is of quite as much importance.

An examination of the water-shed tributary to a reservoir site is therefore a matter of great moment and in the following articles we will briefly discuss the points to be investigated and the lines upon which these investigations ought to be carried out.

All of the territory draining into a reservoir site above the location of the dam is known as its tributary water-shed. To determine the area of this water-shed is the first matter of importance in investigating it.

Surveys from which the number of square miles or acres can be calculated should be made. These surveys should also be topographical in a measure, as the differences in elevation are important, so if the water-shed differs very much in elevation it should be classified accordingly. The exactness with which it is necessary to determine the area of a water-shed must be left entirely to the judgment of the engineer. Sometimes it may be so much larger or smaller than necessary that only a fair approximation of its size is required for making a report. In such cases it is usually sufficient to locate the principal points along the boundary lines of the

water-shed by a system of triangulation and then approximate the boundaries from these.

More frequently it is the case that close figuring is required to determine the sufficiency of the water-shed, in which case its area must be ascertained with great exactness. It is then necessary to traverse the boundaries with a transit line and calculate the latitudes and departures in order to check the correctness of the work and calculate the contents of the water-shed.

AMOUNT OF PRECIPITATION.

The amount of moisture falling on the tributary water-shed in the form of rain and snow should be observed and a record kept. The method of making these observations has already been discussed herein in connection with natural streams and the same rules will apply to observations on

the water-shed tributary to a proposed storage reservoir. Stations at which observations are taken should not be over a mile apart. These stations should be correctly located on the plat of the water-shed, so that a daily record of the results of each observation with the number of the station at which it was made can be kept for future reference.

The value of such observations even made for only one year is considerable, but in order to fix a minimum and maximum rainfall they should be kept for a number of years. Statistics show that dry and wet years occur in groups of from three to ten years. Hence observations must be made for a period covering half a score of years or more in order to ascertain the fluctuations of rainfall with certainty.

(To be continued.)

CASE WHERE AN INJUNCTION DID NOT LIE.

BY CLESSON S. KINNEY.

I SEE by the reports that my friend A. J. Chandler of Phoenix, Arizona, has finally won his case in the supreme court of that Territory by reversing the judgment of the district court. Well, he ought to have won. In the face of express statute of Arizona, and in the face of the almost universal decision of the supreme courts of the Western States and Territories upon the subject the district judge must have spent many a sleepless night in digging up an old common law theory which he thought would fit the case. "Water should, and by right ought to flow where it has been accustomed to flow." A theory so ancient and mildewed that it smells of the peat bogs of England, where the principal question is how to drain the water off from the land and not how to permit to run over them in such a manner that it will do the greatest good to the greatest numbers.

In the case before us, the plaintiffs and appellees were the prior appropriators and users, as between themselves and appellants, Mr. Chandler and associates, of certain water of the Salt river and conducted the same through what is known

as the "Tempe Canal" to where they used it for the purposes of irrigation, and turning a grist mill. Appellants having appropriated, and otherwise secured, the use of water from the river, subsequent to the appropriation of the appellees, at a point in the river several miles above the point of diversion of appellees, for the purpose among other things, of "creating, generating, and perpetuating, for public and private use, a water power of not less than 800 horse power," then sought to mingle the water of the appellees with their own, and run it from the river through their canal over a precipice having a fall of forty to fifty feet where their power plant was located, and afterward delivered it back to the appellees' ditch at a point above any place where the water was used by them, and at the time when this action was commenced to enjoin appellants they were so actually running and delivering said water. An injunction was issued by the district judge and upon the final hearing of the case the injunction was made perpetual, and restrained appellants from interfering with the water of the appellees, except to use it for

mechanical purposes, and provided that said water should after such use be returned by appellants to the natural channel of the river above the mouth of appellees ditch. This requirement was, of course, in strict conformity with the provisions of the common law relative to riparian rights, and upheld the doctrine that water after being used by any person to the extent permitted by common law must be returned to its *original channel* not perceptibly diminished in quantity and undeteriorated in quality.

The Supreme Court held that the common law had no application whatever to the use of water in Arizona. And in the case at Bar it held that an injunction would not lie at the instance of a prior appropriator of the water of a river through an irrigation ditch to restrain a subsequent appropriator further up a stream from diverting water from the river and after using it returning it into *complainant's* ditch, where it appears that the water is turned into such ditch *above* the point where it was to be used by complainant and where the complainant had the *same* quantity as he would have had if defendant returned the part used by him to the river.

Judge Bethune, who rendered the opinion of the Supreme Court, in the course of his remarks said: "It seems to be admitted that there could be no objection to the use by a subsequent appropriator of the waters of a stream already appropriated, should the water be returned uninjured to the channel above the point of diversion of the prior appropriation. But, as we have seen, this rule springs from the common law, which, as already stated, has no application in regulating our water rights. We cannot perceive any reason why, under our system of the use of water, a person entitled to the use of a certain quantity of it should receive it at one place, instead of another, provided his rights are in no way affected or curtailed. The appellees claim a certain quantity of water for the irrigation of their lands and to run Hayden's Mill. If they get it, why should the manner in which they get it matter to them, especially when one may add useless burdens upon the exercise of absolute rights of the appellants, and either way would equally subserve the rights of appellees?"

"In our view of the case, no rights of appellees are invaded by reason of the delivery of the water claimed by them into their ditch above the point of use by them. The evidence fails to show that any damage has accrued, or will accrue, to them by having their water delivered to them at the point to which appellants were delivering it at the commencement of this action, or that their remedies against appellants for a failure to so deliver the quantity of water, to which appellees are entitled, or for any damages otherwise suffered, would be in any manner different from those appellees would have should appellants be required to deliver the proper quantity back into the channel of the river. We are of the opinion that the appellants were exercising an absolute right in the use of the water, of course subject to any penalty they may incur by the use of such right. We therefore do not think this is a case for an injunction, but that the appellees have ample modes of redress at law for any damages which may be occasioned by an improper action of appellants in the use of the water, or in delivering it back to appellees. The judgment of the lower court is reversed, and the cause remanded for a new trial."

The case of appellees was simply another example of the selfishness of man. Not injured in any manner themselves they wished to prevent Mr. Chandler and his associates from using the water and thus preventing the greatest good to be done to the greatest number, and the further development of the country.

But the district judge who granted the injunction, what shall I say of him? His audacity is only equaled by the district judge of Idaho who rendered that remarkable decision upon the theory of "equitable division" of waters in the case of Hillman vs. Hardwick and others (reported in the 28 Pac. Rep., 438). In that case the evidence was that there were about eighty to 100 inches flowing in a certain stream, and the plaintiff claimed by virtue of a prior appropriation 125 inches of water. But in spite of the fact that his claim to this amount and his actual application of all of the water for the purpose of irrigation were both proven, the trial court rendered a judgment giving the defendants permission to divert something like 800 inches over and above the amount claimed

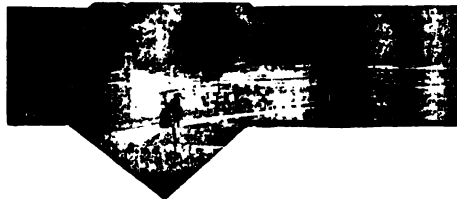
by the plaintiff. Of course the supreme court of that State reversed the judgment below, and Mr. Justice Huston, in rendering the opinion, said:

"We then have this anomalous condition of affairs: A creek or stream flowing 100 inches of water, with appropriations of that water to the amount of 800 inches, in addition to the prior appropriation of the plaintiff of all the water of the creek and its tributaries. To the ordinary mind this might, and perhaps does, present a somewhat difficult problem for judicial solution, unaided by the statutes, but the learned district judge found no difficulty whatever in reaching a conclusion as unique as it is unprecedented. We say unprecedented, because this question, under statutes identical with that of Idaho, has been decided so often in favor of the prior appropriator, that it has been generally considered, by both professionals and profanes, as a settled question; as, for instance, the question has been decided up to 1889, twice by the Supreme Court of the United States, seventeen times by the supreme court of California, five times by the supreme court of Colorado, six times by the supreme court of Nevada, twice by the supreme court of Montana, once by the supreme court of New Mexico, twice by the supreme court of Utah, once by the supreme court of Oregon and repeatedly by the supreme court of Idaho; in fact, the decision of the learned judge in this case stands alone. We have been unable by the most diligent search to find a precedent or parallel for it. Heroically setting aside the statute, the decisions and the evidence in the case, he assumes the role of Jupiter Pluvius, and distributes the waters of Gooseberry creek with a beneficent recklessness which makes the most successful efforts of all the rain wizards shrink into insignificance, and which would make the hearts of the ranchers on Gooseberry dance with joy if only the judicial decree could be supplemented with a little

more moisture. The individual who causes two blades of grass to grow where but one grew before is held in highest emulation as a benefactor of his race. How then, shall we rank him, who, by judicial fiat alone, can cause 800 inches of water to run where Nature only put 100 inches? We veil our faces, we bow our heads before this assumption of judicial authority.

"Evidently the court assumed that Gooseberry creek was as inexhaustible as the widow's crust, or else that its decree possessed the potency of Moses' rod. All the provisions of the statute in regard to priority of right incident to priority of appropriation are ignored, as are the sources and volume of supply."

From the rulings of these two district judges in these cases it is evident that in some parts of the West all do not understand the arid region doctrine of the appropriation of waters. The rights of the first appropriator must be respected. But water is too precious an article in this part of the country to be permitted to run to waste, or to prevent its use to its fullest capacity. The great weight of modern authorities hold that where a person has diverted a certain portion of the waters of a stream and permits a part of the water so diverted to run to waste, or fails within a reasonable time to use a certain portion of the water for some beneficial use or purpose, he can only hold that part of the water diverted which has been actually applied to some beneficial use, and his priority extends only to the quantity so used. Also the authorities hold that in such a case there has been no appropriation as to the water not used and which ran to waste, but that that part might be subsequently appropriated and held by other parties, provided they took the proper steps, and they, themselves, applied it to some beneficial use or purpose. The final test in all cases is, whether or not all of the water diverted is actually applied to some useful or beneficial purpose.



CORN AND ITS CULTIVATION.*

BY H. R. HILTON.

IF we have fairly ascertained the habit of growth of the corn plant and the conditions most favorable to its best development, we can more intelligently adopt methods of cultivation that will most nearly supply these conditions. The studies so far made in corn roots suggest that the food gatherers love a finely-pulverized soil well supplied with humus, in the zone from the third to the tenth inch in depth from the surface. In valley soils containing sand this zone may be increased to 12 to 16 inches in depth. As the surface roots or food gatherers do their principal work in the first 40 days of growth, we are led to doubt whether all the essential conditions can be supplied by listing old corn ground each spring, and preparing the soil for root growth while the plant is growing. This method involves heavy root pruning, or, in avoiding this, leaves a small area of pulverized soil for the feeding roots to work in.

Assuming that all obstruction to free entrance of water into the subsoil by use of a subsoil plow (if such obstruction existed) has been removed, I would favor fall plowing, about 8 inches deep, turning under a green catch-crop of cow-peas, soybeans, Kaffir corn, or sorghum. If the implement is not specially designed for pressing the soil around the vegetable matter turned under to gather the moisture and start it rotting, follow the plow promptly with a disk harrow, and the disk with a drill that admits of the shoe being elevated so as to allow the wheels to sink down into the loosened soil to the greatest depth possible and pack the lower soil while leaving the top soil loose. The harrow should be passed over the ground after every heavy rain till winter sets in, to keep the top soil dry and prevent baking of the surface soil and evaporation of the water. In the spring open lister furrow, keeping, if possible, above the layer of green manure turned under the previous fall.

In order to get as much of the butt end of the stalk below the level of the ground as possible so that more joints may be covered and more circle roots developed, care must be taken not to let any loose dirt roll into the furrow till after the plant

appears, as the first roots which form the base of the stalk develop as near the surface as they can find moisture after the first green leaf appears. Hence the farther below the level of the ground the first leaf comes through the soil, the longer will be the section of the stalk below the surface and the greater the number of roots that can be developed.

As the plant grows in the lister furrow only the finest soil should be allowed to sift in around it, till the ground is all brought to a level, to facilitate the development of new roots as new joints are formed in the stalk and covered by the soil. If the soil is very fine textured and warms up slowly in the spring, or if the planting is done very early in the season, then a deep cultivation of the hill between the rows may be helpful in warming the soil to a greater depth, so as to make more favorable conditions for root growth at a greater depth, and prevent the first roots from coming so close to the surface early in the season, within the range of the cultivator tooth. After the plant is six inches high, and the soil warm enough for root growth to a depth of one foot, the cultivation should not exceed three inches in depth, and should all be for the purpose of drying out the top soil to conserve the moisture. With many the object of cultivation is simply to destroy weeds, but if the ground is promptly cultivated after every rain there will be no weeds, as small weeds cannot develop when the top soil is kept dry for two inches in depth. In wet seasons large cultivators may be needed to destroy weeds, but for dry-soil mulching a small-toothed cultivator, or one with narrow spring teeth, the points set well forward, so as to cut the top soil clean from the soil below, and to run shallower beside the corn row than in the middle of the furrow, will usually mulch the soil best. The forward reach of the spring tooth brings the clods and coarsest material to the surface, and sifts the finest soil underneath, lessening danger of loss by the wind, and leaving the surface roughened, so as to break the force of heavy rain-drops that tend to compact the surface, a condition favorable to baking as it dries out.

*[In the Kansas Board of Agriculture Quarterly.]

CORN ON LAND NOT SUBSOILED.

The rule with a majority of farmers is to cultivate four times and quit. One good rain after corn is "laid by," if followed by dry weather, will do more harm to the crop, on a fine-textured soil, than if no rain at all had fallen after the last cultivation. The plant needs its greatest supply of moisture at the time of blooming, and to insure favorable conditions shallow cultivation, with single-horse, five- or 12-tooth cultivators, or an "A" harrow, is essential till the crop is practically made. Late cultivation makes a fine seed bed for winter wheat to follow corn, and take up the nitrogen made available too late in the season to be taken by the corn plant and in danger of being wasted. If a wheat crop is not desired, sow rye for this purpose, and plow under in the spring.

CORN ROOTS ON SUBSOILED LAND

Figure 2 shows the root of a corn plant uncovered in 1895 on Scott Kelsey's farm, in the Kaw valley, Kansas, just east of Topeka, grown in the track of a tree-digger that, in taking up nursery stock in the fall of 1894, had pulverized the soil 18 inches deep and 20 inches wide. The track of the tree-digger in its width and depth was a mass of fibrous roots. In the zone between the tree-digger furrows, where the ground was hard, there were few fibrous roots, and a limited number of large, smooth roots. This field yielded 84 bushels per acre in the season of 1895. The subsoil roots were followed $4\frac{1}{2}$ feet down, but the ends were not found. By way of contrast, see Fig. 3, on upland, four miles north of Topeka, never plowed over six inches deep. All the fibrous roots (food gatherers) were found in the lower two inches of the cultivated soil. A cultivator tooth running four inches deep would leave only two inches in depth of cultivated soil for the food gatherers to work in between the rows—entirely too limited an area to secure good results. The root development was small, and only two joints were covered sufficiently to send down subsoil roots. The yield was under 40 bushels per acre.

As corn roots use the water in the soil to a depth of five feet at least, this would give 25 cubic feet of soil for each plant to root in, and, when fairly moist, would contain about 20 gallons of water, available for the use of the plant. This would be more than two thirds of the quantity needed to make a 60-bushel-per-acre crop, and

equivalent to a rainfall of nine inches. How much the plant gets depends on the cultivation given the soil to check evaporation. On a majority of Kansas farms all corn-stalks in excess of 8,000 per acre are weeds, robbing the 8,000 plants of the moisture they so much need to perfect the grain. If one stalk in five square feet of ground can not perfect the seed, how much less likely are two stalks occupying the same territory to do so? Every surplus plant is a "dog in the manger," that can not bear fruit itself and prevents its neighbor from doing so by stealing its moisture.

Seed corn should be selected from the

stalks that have shown best adaptability to their environment and best withstood adverse conditions. This selection should be made when the ear is ripening, and stalks marked by tying a red tag on each one. When corn is ripe these marked ears can be picked and put away for seed.

Study the growth of roots and soil conditions where the best corn-stalk on the farm grows; also the roots and soil where the poorest corn grows. A comparison will help to a better knowledge of what the corn plant needs and to better methods of cultivation.

THE ELECTRIC PLOW IN GERMANY.

BY W. C. FITZSIMMONS.

IN the October Consular Reports, Mr. Otto Doederlein, United States consul at Leipsic, Germany, gave a most interesting account of the practical operations of a plow propelled by electrical power, and giving great satisfaction.

The details cannot be here given, but it may be stated that electricity as a practical feature in the most important of all farm work, that of hauling the plow, is fully established. To show this it is only necessary to give the final figures of cost as compared with that of plowing by means of animal power and steam. Assuming that the farmer has a ten-horse power threshing engine to run the dynamo, the cost of plowing an acre of land to a depth of 9.24 inches is given at \$1.29 per acre, as against \$2.74, the cost of doing the work with oxen. Under favorable conditions the expense could be reduced to \$1.14 per acre. In all cases it was less than one-half that of doing similar work with oxen.

It was also found that, as compared with plowing by steam, the cost by electricity was less than half. Whether for work on a large or small farm the Germans have found electricity much the cheaper motive power for the plow. In this connection we quote the words of the consul as follows:

"It is thus evident that the working expenses of the electric plow for extensive husbandry amount to less than half of those incurred in working the steam plow. This contrast is readily explained, for the capital sunk in the plant is only one-third of that required for the steam plow; the expenses connected with the generating of power are materially lower than is the case with the steam plow, in which a very considerable surplus power has to be raised in order to work the pulleys and brakes and to overcome the stiffness of the rope.

"I have been informed by the director of the Haale factory that electricity will shortly be also used in digging potatoes and sugar beets."

Right here is an opportunity for Western manufacturers as well as for those interested in the development of electrical power. We have almost unlimited water power in the arid States in the mountain streams which can be and at no distant day will be utilized for hauling plows and doing other farm and ranch work on our great plains and in our fertile valleys.

The door to an immense industrial development stands wide open before our men of capital and enterprise. Will they enter and reap the rich rewards?

THE DIVERSIFIED FARM

In diversified farming by irrigation lies the salvation of agriculture

THE GENTLEMAN-FARMER.

BY F. C. BARKER, OF NEW MEXICO.

NEARLY every one knows what is meant by the term gentleman-farmer, although the meaning is somewhat difficult to define; for the fact is there are many kinds of gentleman-farmers. In the first place we have the gentleman who is farming for pleasure only. So long as he is content with the pleasures to be derived from the occupations of a rural life, he is likely not only to be satisfied with himself, but his neighbors will benefit from the many experiments which gentleman-farmers are prone to indulge in. Such men are the most useful members of an agricultural community.

There are, however, other classes, of whom we have unfortunately too many specimens in the irrigated districts of the West. We have the gentleman-farmer who wishes to combine pleasure with profit, too often lured on by the roseate hues of the boom literature of this new country.

Now I am by no means deprecating the idea of deriving pleasure from one's business, indeed I can hardly imagine the successful man who does not do so. But far too many men are anxious to engage in agriculture or horticulture without having the previous experience which will enable them to form any idea of whether such a life is likely to prove pleasurable or otherwise. When such men find that life on a farm is not a continuous round of pleasure, but that there are many difficulties to be overcome, disappointments to be borne and hard work to be done, they are apt to be soon discouraged.

The fact is that the successful farmer has longer hours to work and harder work to do than falls to the lot of almost any other man, and this holds good on the irrigated farm perhaps quite as much as where the advantages of irrigation are absent. The farmer, however, has this advantage over most other men. He can perform his work cheerfully knowing that he is not working for any other man, but that the whole produce of his labor will be enjoyed by himself or by those he loves.

His is an independent life and he is not at the beck and call of any boss or at the mercy of any capricious customer. Every evening he has the pleasing satisfaction of feeling that he has accomplished something of which he himself will see the result and reap the benefit. He knows that good work will bring him not only financial success, but, that which man esteems above money, the approbation of his neighbors. Thus the good farmer gets to take a pride in his work, and what to others may be merely toil is to him a pleasure. I fear that very few of our gentlemen-farmers look upon the matter in this light, but when they do not, farming is likely to prove a curse to them and they a curse to farming.

Lastly we have the gentleman-farmer who expects to spend the money while the other fellow does the work. This class is especially numerous on irrigated farms. Call at his farm and ten to one you find him absent. Either he is on a hunting expedition, or he has gone for the mail or is in town on some small shopping errand that might well have been left to his wife. If by chance you find him at home he is either reading the daily papers or smoking a cigar on the piazza. The last thing he ever thinks of is to take off his coat and go to work with his hired men. If he keeps a cow, a hired man does the milking and a hired girl makes the butter. If he has a vegetable garden, the hired man does the hoeing and digging. No wonder he tells you that he can buy butter and vegetables cheaper than he can raise them and that pigs don't pay.

He who expects to lead a "sweet do nothing" life as a farmer is apt to have his castle of indolence rudely shaken to its very foundations. It is of course possible to make money on a farm where the labor is done by hired help, but the farmer himself will have to work as hard as any of his laborers. The hired man does not as a rule feel any pleasure or take any pride in his work. He will need constant watching, and the farmer who not only watches his laborers, but sets them the example of good work is as a rule the successful farmer.

COST OF RAISING CORN IN KANSAS.

KANSAS is certainly a great corn State. Statistics show that the average annual yield for all the thirty-four years, bad seasons and good, since 1861 has been twenty-seven bushels per acre for the entire State, ranging in different years from 9 to 48½ bushels. The product for twenty-five years ending with 1895 has had an annual home value averaging more than \$31,000,000 and a total value in that time exceeding \$776,000,000.

Secretary Coburn, in the March quarterly report of the State Board of Agriculture, presents a detailed showing from 68 long-time extensive growers, in 45 counties which last year produced 140,000,000 bushels, giving from their experience "on such a basis as others can safely accept" each principal item of cost in growing and cribbing an acre of corn, estimating the yield at 40 bushels. About two-thirds of those reporting prefer planting with listers and the others use the better known check-row method, after the land has been plowed and harrowed.

The statements of all the growers summed up, averaged and itemized show as follows:

COST OF RAISING AN ACRE OF CORN.

Seed.....	\$ 0.07
Planting (with lister, or with check-row planter including cost of previous plowing and harrowing).....	.77
Cultivating.....	1.03
Husking and putting in crib.....	1.18
Wear and tear and interest on cost of tools.....	.25
Rent of land (or interest on its value).....	2.41
Total cost.....	\$5.71
Cost per bushel.....	.14½
Average value of corn land per acre.....	\$29.25

The condensed showing made by the 43 growers who plant with listers, or have found that method preferable, is thus:

Seed.....	\$0.07
Listing.....	.44
Cultivating.....	1.06
Husking and putting in crib.....	1.16
Wear and tear and interest on cost of tools.....	.25
Rent of land (or interest on its value).....	2.44
Total cost.....	\$5.42
Cost per bushel.....	.13½

Statements of cost, where the land is plowed, well harrowed, and planted with the ordinary check-row machine, summarize for each item as follows:

Seed.....	\$0.07
Plowing.....	1.03
Harrowing.....	.24
Planting.....	.25
Cultivating.....	.98
Husking and putting in crib.....	1.18
Wear and tear and interest on cost of tools.....	.30
Rent of land (or interest on its value)....	2.35
Total cost.....	\$6.40
Cost per bushel.....	.16

Commenting on these figures Secretary Coburn says: "In none of these calculations has there been made any allowance for the value of the corn-stalks, which ordinarily, under the crudest management, should offset the cost of harvesting the grain, and under proper conditions should have a forage value much in excess of such cost. Taking these into every estimate, as should rightly be done, the showing of cost per bushel would be very sensibly diminished. In the results of this investigation it will likewise be noted that the rental for these Kansas corn lands, or the interest figured by their owners on the investment represented, averages more than 8½ per cent. or a net rate higher than the capitalist, general banker or money-lender dreams of realizing.

"Further, it should be understood that the thrifty Kansas farmer does not measure the profit of his crop by the narrow margin shown in such statistics between the items of 'cost' and 'value.' He does not, as a rule, anticipate selling his corn by the bushel at the figures given as 'value,' nor expect more if he did so than a moderate return, one year with another, for his labor and investment; it is the conversion of it, on his farm, into beef, pork, poultry, dairy and similar products from which comes the surplus to make the comfortable homes and build the school-houses, colleges and churches that are such common objects on his horizon and so largely the measure of his ambition."

CALIFORNIA LEMON GROWING.

THE Azusa Pomotropic has the following interesting and instructive article on lemon culture:

"A large number of our readers are engaged in lemon culture, therefore will read with interest anything that bears upon that industry in this locality. It seems strange that the forecasts

of extremely low prices early this spring are not being verified. Scarcely any one believed there would be much sale for the fruit at remunerative prices till July or August. Advices from the East have predicted the usual depression in the lemon market, but we notice both the lemon companies at Azusa keep busy receiving and dispatching the fruit. Furthermore, we are informed that the demand is brisk and the supply inadequate and that good prices are prevailing. No one doubts that the better care in growing, picking and curing has much to do with better markets, for the trade is learning that it is getting less and less precarious to order California lemons in large quantities and that they can be supplied in satisfactory quantities from this State.

"Before experience taught our growers, they did not suppose that a warty or ridgy lemon was more subject to decay than a smooth lemon of exactly the same internal texture. Now they know it is next to impossible to preserve the oil glands in the rough lemon during the picking and curing period. Experience has shown that a smooth lemon properly matured, gathered and cured escapes injury much more thoroughly than a rough one of the same class otherwise. By observing common sense methods, the California growers are putting forth a grade that the trade is getting to rely upon and firmer prices are maintaining wherever the fruit has been tried.

"An examination of the lemons now curing in the association packing house at Glendora shows a very large majority of them grown with smooth skins, and invariably they stand the curing ordeal better than the corrugated and lumpy fruit of the same general quality. Mr. Scott, the manager, attributes the production of finer fruit to closer soil assimilation, greater age in the trees and common sense pruning, with great emphasis on the latter clause. 'Put on the tariff and lop off the water sprouts,' might be nailed to Scott's office door as the theme of his daily discourse, varied with reflections on ripe-lemon pulling, carelessness in handling, over-irrigation and—lopping off the water sprouts again.

"Since his advent at Glendora he has interrogated every sentence with a pruning hook. He believes in his theme—

it may prove to be a mission to this valley, where lemon trees grow like eucalyptus—and he stays with it every day in the week. It is well to have a monitor in the association for it cannot select the good and refuse the bad that comes to a lemon curing establishment, and its success is dependent in a good measure on securing as little poor fruit as possible, for its members have a right to have their entire output cared for. Agitation for better methods should be the association's watchword and is, and while Mr. Scott's theories on pruning are most radical they are rational and are producing results to be proud of in their application."

Feeding Cattle.—L. L. Roy, of Topeka, Kan., has recently made a careful test in feeding flaxseed meal to twelve rough cattle. They weighed when bought 10,340 pounds. In seventy-five days they gained 4,610 lbs. The shrinkage before sale on the market was 710 lbs., partly due to bad handling. The ground meal cost about one third more per ton than corn. The cattle were in such prime condition that they brought .40 cents per hundred more than other cattle of the same weight sold the same day. The summary as made in Colman's Rural World shows:

This very valuable feeding test established beyond question several new points in feeding, and strongly emphasized some others. Among them are the facts that ground linseed meal

Makes meat quickly.

Makes meat at less money than other feed.

Makes more meat than other feeds.

Makes absolutely healthy meat, which is worth much in the steer or hog, and worth infinitely more to the person who eats it.

Makes a loose hide, a good digestion and the best possible general appearance.

Makes meat that sells for more money than animals fed on other feeds.

You can feed without danger, as much of it as the animal will eat. The more you feed the more meat you get.

Do not be afraid to feed it liberally. It is feed, and not medicine.

It contains three times as much nourishment as corn, and does not cost much more than corn. Therefore, it is cheaper than corn.

MAXIMS FOR THE IRRIGATED FARM

Push your work; never let it push you.
It is the early spraying that will prevent the worm.

There is never lack of demand for the best butter.

Theory and practice must go together in good farming.

Potatoes must have loose earth in which tubers may expand.

There is greater explosive power in an idea than in a bomb.

Read critically. There is much written that is not Scripture.

You cannot compete in butter making these days with poor cows.

It is easier to keep out than to drive out insect pests from the orchard.

Good horses command the best prices even though less than formerly.

Stick to the crop that pays you well, to what you are successful in doing.

If a cow's attention is attracted she immediately lets down her milk.

It is better to coax than to beat a nervous cow. You will get more milk.

A boy should be educated to make a farmer as much as to make a doctor.

Business principles are just as important to the farmer as to the merchant.

Whatever you do if done well stays done and saves time, trouble and worry.

Turning under green crops is one of the cheapest and best methods of fertilizing.

Even bacteria have their uses. You cannot make cheese without their assistance.

Co-operative enterprises need good management, or they will fail as others do.

Be careful in the selection of seeds. It will improve the crop and increase the profits.

It is necessary to mature your lambs for the market, as well as to give them growth.

A chief advantage in dairying for the farmer is, that it causes no depletion of the soil.

The reading farmer may profit by the experience of others, and it contributes to his success.

Never rush the cows from pasture to stable, and never set a dog on them. It means money loss.

Free discussion of methods among neighbors will improve the general neighborhood conditions.

Feed your strawberry beds early and well, and they will give you bounteous return of luscious fruit.

Ensilage is not only nutritious but appetizing. The silo is an excellent provision in the farm equipment.

It is the duty of the farmer to live better than anybody. He has only to improve his opportunities.

A man need not work himself to death because he is a farmer. Mind may do a share as well as muscle.

A horse is more liable to scare with than without blinders. He is seldom afraid of what he can fairly see.

Not all knowledge is gained from books. With an open eye and mind the man at work will get a good education.

Do not use too much water. Your thirst may be satisfied without drowning you. It is the same with a plant.

The meannesses of human nature are a bar to co-operative effort. There is too much pig nature in the combinations.

Nothing pays better on the farm than to keep accurate accounts—to know what is raised at a loss and what yields profit.

Be sure to get the bulletins from the agricultural experiment stations. They are doing important work. Keep in touch with it.

Governments are too apt to be great machines for robbing and oppressing the people. If ours is so used it is the people's own fault.

Be careful in selection when buying trees. One variety will bring profit, another will cause you loss. Foresight is better than hindsight.

Don't waste the straw. It may not be as nutritious as good hay, but it contains enough food and fertilizing properties to be well worth husbanding.

Never forget the duty of the good citizen to vote. You cannot have success without good government; you cannot have good government unless each man contributes his share toward putting the best men at the helm.

PULSE OF THE IRRIGATION INDUSTRY

PRACTICAL CO-OPERATION.

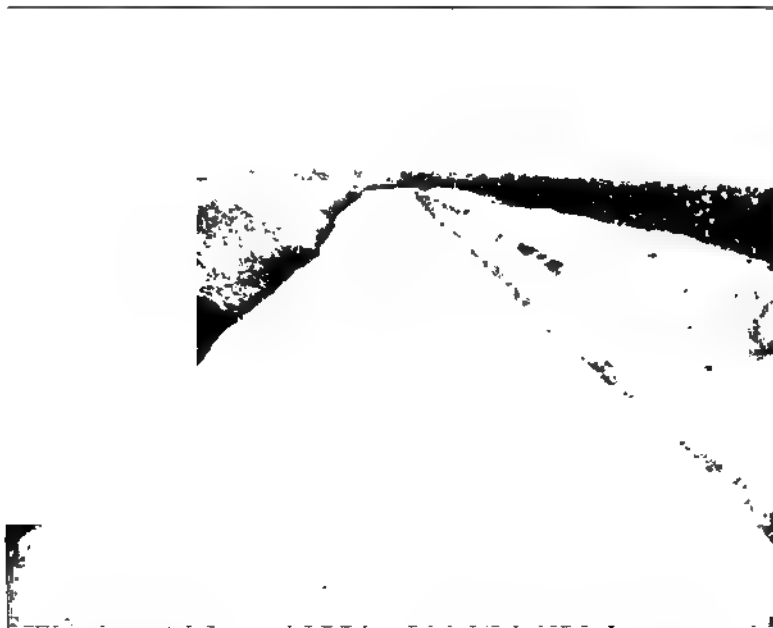
THE Owyhee Canal in Malheur county, Oregon, is an example of what can be accomplished by practical co-operation among farmers.

The canal is twenty-five miles long and carries 20,000 inches of water. It is twenty-two feet wide at headgate, twenty feet wide on bottom for first ten miles, and cost \$100,000. It covers 25,000 acres of land, all of which has been located, and

of the company payable in eighteen months, the stockholders accepting the notes in payment for work the same as they did stock, thus enabling the company to complete the canal and turn the water in for irrigation.

The property was then bonded for \$50,000 and the notes redeemed with proceeds from sale of the bonds.

The canal is now substantially built throughout its entire length, all fluming being avoided, and every dollar spent in



THE OWYHEE CANAL IN OREGON.

the locaters of these lands are the owners of the capital stock of the company.

The capital stock of the company is \$100,000, divided into 10,000 shares of the par value of \$10 each, 8,500 shares of which have been subscribed by, and are in the hands of actual settlers under the canal, and on which about \$6 per share have been paid into the treasury of the company in labor on construction of the canal. The excess of cost above amount obtained from subscriptions to the capital stock (about \$50,000) was raised by notes

its construction was represented in honest work by the owners and their teams. The company has never had any money, and this great canal simply represents what men with honest hearts and willing hands can do. After they had exhausted their own resources they took the company's (virtually their own) notes which resident merchants magnanimously accepted in payment for supplies, and this enabled them to complete the work.

The Owyhee river is a perennial stream which perpetually flows a much larger

volume of water than the canal is able to carry. From this stream, at the mouth of a rocky canyon through which it flows for sixty miles above, the water for this canal is taken and no ditch can ever be taken out above it. Thus the complications arising from conflicting rights to the waters of this river will forever be avoided.

This enterprise was undertaken a few years ago when the farmers of Eastern Oregon realized that irrigation was necessary. Under the able management of Mr. T. T. Danilson of the K. S. D. Fruit Land Company the work was rapidly pushed forward in spite of the fact that many of the farmers were discouraged and failure seemed imminent. Mr. Danilson had great faith in the ultimate outcome of the enterprise, and for months the farmers who were building the ditch obtained their supplies from his general store in Ontario, paying for the greater part of the same in work.

This canal is at the present time furnishing an abundant supply of water for the farms and orchards adjacent, and its one great feature is that every owner of an acre of land watered by it is a stockholder and has a voice in the management of the canal company.

IRRIGATION IN WESTERN CANADA.

BY A. H. FORD.

IRRIGATION is taking thousands of settlers along the line of the Canadian Pacific Railway. The Canadian government has recognized the value of a constant supply of water for the farmer and has issued a volume descriptive of the work already accomplished.

It is because of its remorseless energy in promoting every practical reform of real interest and use to the farmer that the Canadian Pacific railway successfully draws settlers from not only Europe, but from our own prairie States. An example is set which should not be fought by legislation adverse to the great system of railway, across the border, but which should be emulated by our own government and railroads.

The Canadian Pacific railroad is determined to make the territory through which it passes known to the world as a cultivated garden 4,000 miles long and several hundred wide. No expense seems

to be spared to improve the fertile fields through which the great lines of iron run.

The Canadian Pacific railroad stretches across the continent and is striving to become the highway of travel and traffic between England and Japan, with facilities for the tourist, who can sail from Liverpool in a Canadian Pacific steamship and never leave the care of the company until he is landed in China.

Selfish motives may govern this great corporation, but if it will assist in the irrigation of its territory and make the great Northwest even a greater garden spot than it is, no one should find fault if the railroad is also a gainer, and many American railroads would do well to study a system which will convince settlers that they will be treated as friends of the transportation company near whose line they locate.

The people of British Columbia and Alberta have learned that irrigation doubles crops even where there is abundant rainfall, and vast tracts of formerly arid land in this region are being opened up by irrigation and proving to be the richest lands in the world.

The eyes of the home seeker will be turned to the Northwest as long as the Canadian government and the Canadian Pacific railway make the prosperity of the farmer a part of their business.

A MONTANA CONVENTION.

AT the Montana Mining and Immigration Convention held in Helena a month ago the resources of the entire State were taken up and ably discussed by a number of the leading men who were present. An invitation was extended to those in the over-crowded portions of our own country to assist in developing Montana which with the vast area of 146,000 square miles has a population of about 185,000.

J. C. Auld, of Glendive, secretary of the Arid Land commission, stated that irrigation would be the greatest source of power and riches. In the smaller valleys of Montana the question would naturally solve itself, as the land was fertile and the water supply ample and easily obtainable. Individual or co-operative ditches could be built with a limited amount of capital. In a general way Mr. Auld stated that it

at this time to correctly estimate the value of Governor Jones' work, or to befittingly express the sense of loss at his untimely decease.

FOURTH NATIONAL CONGRESS REPORT.

I HAVE frequent applications for copies of the Proceedings of the Fourth National Irrigation Congress, held at Albuquerque, New Mexico, September, 1895, but am compelled to refuse all applicants, because the proceedings of the congress have never been published.

A word of explanation at this point is due to the members of the congress and is also due as a matter of justice to the members of the National Executive Committee of 1895. The proceedings of all previous congresses have been published by the Convention cities. The National Committee has no funds for such publication. No assessment was ever made on delegates to the congress, and the expenses of the meetings, usually from \$3,000 to \$4,000, have always been borne by the city in which the congress met. The citizens of Albuquerque and New Mexico spent a large sum of money in advertising the congress, in providing a place of meeting, in badges, program, etc., and probably do not feel justified now in expending an additional \$500 to \$800 in printing the proceedings.

The local press at Albuquerque, though hampered by limited facilities and hindered by the existence of the Territorial Fair during the same week, gave most excellent reports of the proceedings of the congress, printing much of the discussion and many of the papers in full, so that the delegates, by saving the local papers, were all able to take home with them reasonably complete reports of the meeting.

I have made this explanation thus lengthy and in detail in order to silence, if possible, the criticism which seems to exist in some quarters against the old Executive Committee for not publishing the proceedings of the Albuquerque Congress, for it is a matter with which the Committee has had nothing whatever to do.

FRED L. ALLES,
Los Angeles, Cal.

Secretary Fourth National Irrigation Congress.

THE LATE GOVERNOR JOHN E. JONES, OF NEVADA.

was possible to construct reservoirs by building dams across coulees or ravines, and thus impound large bodies of water capable of irrigating immense areas of land. The water now going to waste in the larger rivers, the Missouri and the Yellowstone, as well as their tributaries, the Sun, Milk, Big Horn, Tongue and many others, was simply enormous.

Other speakers were Governor J. E. Rickards, Prof. S. M. Emery, of the Experiment Station at Bozeman, Jerry Collins, Jas. M. Mills, commissioner of the bureau of labor, E. Larssen, Chas. S. Fee, General Passenger Agent of the Northern Pacific, J. K. Foote, T. E. Collins, D. R. McGinniss, Moses Folsom, of the Great Northern Railway, Judge Strevell and C. R. Middleton.

THE DEATH OF GOVERNOR JONES.

IN the death of Governor John E. Jones, of Nevada, not only the State but the entire West has lost a true friend and an honest and faithful worker for its best interests. Governor Jones was an ardent advocate of irrigation, and probably to his efforts more than those of any other individual is due the firm foundation which has been laid for the future development of the State of Nevada. It is impossible

HOW ONE WOMAN FIGHTS THE DROUGHT.

One of the farmers of large areas in Kansas is Miss Mary Best, of Medicine Lodge, says the Kansas Farmer. English by birth, she naturally cast her eyes over the Queen's dominions, when the trouble with the dry weather came on, to see if anywhere under the government on whose lands the sun never sets a remedy for drought had been found. Yes, in India irrigation is old and irrigation is new. Millions have recently been invested in its development. The subject was thoroughly studied and the first practical result on Miss Best's farm was the reconstruction of an old dam in the Medicine river. The next was the construction of a number of Jumbo windmills and home-made pumps. Water was turned on during the winter. A large tract was kept flooded about a foot deep for several days. After the spring opened it was a long time before this flooded land got dry enough to list. Sixty acres of it were finally listed to corn. This land was rather too wet to cultivate easily, but the corn prospered. The lashing of the hot winds did not affect it. Those winds did, however, drive the "Jumbos" at a furious rate and lifted great quantities of water.

Miss Best's farming is considerably diversified. With her present knowledge of how to fight the drought it will be sure in its results and profitable.

MINES AND MINING OUTPUT.

It is claimed that the mines of Idaho have added \$300,000,000 to the wealth of the world.

It is estimated that 10,000 people will go into the Yukon country this spring, and steamer loads are going from all the Pacific coast ports.

THE Hematite mining district in Northern New Mexico is attracting attention, and they are claiming it to be the Cripple Creek of that section.

THERE is a considerable development of gold mining in the Cache valley, Utah, where good finds are being made and considerable work is in progress.

THERE is a steady cheapening of the cyanide process, and within a brief time it

is thought it will be possible to treat four and five dollar ore successfully and profitably.

THE Flagler smelter, at Silver City, New Mexico, which has been a long time idle, has been started again under vigorous management, and has ore in sight for a long and profitable run.

It is reported from Bakersfield, Cal., that a very rich discovery of gold quartz has been found in the desert region southeast from there. Experts pronounce the mines very rich, and a rush of miners has set in.

THERE is unusual activity in the Elizabethtown mining district of Northern New Mexico. It is an old camp and has yielded a large amount of gold in the past. It seems to be improving with development.

A TOWN SITE outfit, said to be backed by the Santa Fe road, started from Trinidad recently for the Baldy mining district, and a branch line is said to be talked about to leave the main line near Maxwell City, New Mexico.

ALL the mining districts of Arizona claim to be sharing in the general prosperity of the industry. The resumption of work on old properties, the discovery of new ones, and important strikes in every direction, is the rule throughout the Territory.

THERE is intense activity in all the mining districts of Utah, both in the gold and silver districts. It has been possible to operate the silver mines of this State profitably despite the heavy decline in the price of that metal. The chief public interest centers about the Mercur district where the adoption of the cyanide process is rendering the mining of low grade gold ores exceedingly remunerative and with a comparatively small investment for the necessary plants. The ore bodies are being found over a wide area and in immense deposits.

It is fortunate for Cripple Creek that the wholesale business of organizing and floating wild-cat mines has met a check, even though it may throw some measure of discredit upon the legitimate and well-managed properties temporarily. The great number of strikes that are being reported from all parts of the district, and

more than all the vast output of high grade ores that is steadily growing in volume insure a finally satisfactory outcome. There is no camp in this country, if in the world, which has made or is making so large return for the money actually invested there as Cripple Creek.

AN INDIANA IRRIGATOR.

The original irrigator of Indiana is Captain Orville T. Chamberlain, of Elkhart, who has recently been presented by Congress with a gold medal for gallantry upon the battlefield of Chickamauga on September 20, 1863. Captain Chamberlain is a thorough believer in irrigation and has adopted it upon his large farm near Elkhart.

A BANNER COUNTY.

Scott's Bluff still continues to be the banner irrigation county of Nebraska. In a recent letter to the Omaha World-Herald, J. W. King states that he has farmed in Indiana and Iowa, but prefers Nebraska and irrigation to uncertain crops under rainfall. Charles H. Simmons is also one of the original irrigators of Scott's Bluff county, and he is enthusiastic on the subject. "Better crops, larger crops, and above all they are sure," is the way he puts it.

ARIZONA.

A hotel to cost \$150,000 is to be built in Phoenix by J. C. Adams, a Chicago man.

The Butte reservoir site has been withdrawn from public entry. It is in Pinal county and covers 1640 acres.

The property of the Agua Fria Construction Company was sold under attachment April 2. It is evidently a movement toward reorganization—a freeze-out of small share-holders, probably.

Governor Hughes was knocked down in the presence of at least three others. A newspaper man named Clark was the only one near enough to have done it, but nobody saw the blow, not even the governor, and Clark was declared "not guilty."

The Rio Verde canal company of Phoenix, Arizona, report that they have sold bonds to the amount of \$2,400,000, which will insure the completion of their irrigation system and is the most encouraging news that irrigation promoters have heard since the panic of '93.

The Phoenix Gazette summarizes the local conditions as follows: "Cattle men are happy, stock brings better prices than ever before, and the ranges have, in most localities, excellent pasturage. Every canal in the valley is full of water, and there is some to spare." With the expenditure of \$2,000,000 for the Rio Verde canal within the next fourteen months and the probable starting of other large works, there is reason for good times in Arizona.

The latest news regarding the status of the Gila Bend irrigation works is that all the interests, including the various construction companies and Governor Wolfley, have combined against the Peoria crowd. The litigation now goes to the U. S. Supreme Court, where a few years will be required before a decision is handed down. From what appears to be reliable authority, the Peorians tried to manipulate the irrigation enterprise à la whisky trust style, and are about to get the worst of it.

CALIFORNIA.

It has been a favorable winter for stock in most parts of the State.

The Producers Raisin Packing Co. of Fresno, is enlarging its plant.

A total of 488,710 tons of fruit were exported from the State last year.

Four hundred acres of olives are being planted at La Mirado near Fullerton.

The spraying of fruit trees is being done systematically at Fresno with excellent results.

There are ten Washington Navel trees being planted to one of any other variety of oranges in Southern California.

Moreno irrigators are being charged 35 cents an inch per day, the highest rate of any irrigation district in the State.

Redlands is prospering, having obtained fancy prices for its fine orange crop, which escaped the frost this year as it has heretofore.

The Sacramento Packing and Drying Company will pack the product from 230 acres of peas now growing in and around Acampo.

Japanese hemp is proving to be adapted for profitable cultivation. A fair yield is two tons per acre, and the market price 8 cents a pound.

It is predicted that in two or three years California will have enough English walnuts, of superior quality, to supply the United States.

It is claimed that a million olive trees have been set within the last two years. California olives are steadily gaining favor in the markets.

The San Bernardino rock pile is short on labor. The industry is so little appreciated by tramps they are giving the country a wide berth.

It is stated that from forty to forty-five per cent. of the West-bound tourist travel this season have gone to make their homes in Southern California.

Higher prices for oranges at Redlands has created such a demand for trees as to exhaust the nursery stocks, and planting seed beds is again in vogue.

A poultry ranch with a capital of \$25,000, with capacity for an annual production of 90,000 broilers and 2,000,000 eggs, is being established near San Francisco.

The year's planting of orange trees has been unexpectedly large, and the demand for olive trees has been so enormous that the supply is practically exhausted.

Cahuenga vegetable growers have reaped a rich harvest this winter, shipping string beans, green peas and tomatoes to San Francisco. Tomatoes fruit there all winter.

The Redlands Citrograph says the "Damascus Town Site" is a "gigantic fraud, a tremendous fake, and a scorching swindle," being located out on the Salton desert.

The big storage reservoir of the Poso Irrigation District has been completed and the water turned in. It will take six weeks to fill it at the rate of 30,000,000 gallons daily.

The application of the Alta Irrigation District for the cancellation of its county assessments, on the ground that it is a municipal corporation, has been granted. It raises a point of wide-spread public interest.

Good orange lands are in active demand in Southern California at round prices, it being generally comprehended that the area of such lands, of good quality and safe from frosts, is comparatively very limited.

A subscription of \$3,000 has been made to a cannery company at Redlands, conditional on a total local subscription of \$5,000 and payable when two acres of ground and a plant capable of packing 50,000 cans of fruit, and costing \$12,000, has been erected.

COLORADO.

Medford is sending 600 boxes of Newton pippin apples to the London market.

A large ice plant is being erected at Grand Junction, and is expected to be in full operation early in May.

Colonel R. J. Hinton, of New York, has been recently in Colorado examining a number of projects for Eastern capitalists.

The Greeley Tribune proves pretty conclusively it will not pay to feed lambs for market in that section on alfalfa hay at \$2 per ton.

The scarcity of snow in the mountains prompts the State engineer to caution water consumers to save and economize the probably limited supply.

Of the 250,000 acres of land that will be available for cultivation in the Grand valley when brought under irrigation only 75,000 acres are now under ditch.

It was estimated that in the Grand valley holes were dug for the planting of between 750,000 and 1,000,000 fruit trees when the water was turned into the irrigating ditches.

The Rio Grande Railway Company are arranging to erect a large fruit warehouse near the depot at Grand Junction to facilitate fruit shipments. The business has outgrown the usual methods of handling and present accommodations.

Professor Carpenter of the Agricultural Experiment Station is planning to make an irrigation survey of the San Luis valley during a portion of the summer, with the help of the water commissioners and ditch companies of that valley.

The Pawnee Pass Canal and Reservoir scheme, which will cover much excellent land on the north side of the South Platte river in Colorado, is expected to be built. There are now a number of corps of surveyors at work on the enterprise, among them being Messrs. Walters, Preston and Stimson, former students of the Agricultural College.

The supply of snow at present in the mountains of Colorado seems to be less than the usual amount. This does not necessarily mean that the streams will be low, but unless the rains of spring and of May and June are more abundant than usual, it will follow. With late snows the high waters are usually early, as the snow melts soon. The cutting off of the forests, and their destruction by fire, has caused the loss of the natural covering which formerly preserved the snow until much later in summer than it is now commonly found.

IDAHO.

Squirrel-shooting parties are necessarily popular in the Palouse country.

The construction of an irrigation plant is in progress for the Asotin flats in the Snake River valley, near Lewiston.

The Idaho Canal Company, under the presidency of Mr. Frank W. Smith, has commenced work, and 100 teams are now engaged in construction.

Two colonies of Iowa Dunkards, numbering about seventy in all, have recently located in Idaho. This is the beginning of a considerable movement.

The Electric Light Company of Boise has doubled the capacity of its plant. It now has 660-horse power, and will furnish power for manufacturing purposes.

A statement was recently made under oath in court by a well-known fruit grower of Lewiston that the average profit from his farm in a year was \$700 an acre.

An immigration congress has recently been held at Boise City, which resulted in a permanent organization to promote the general welfare of the State. An effort will be made to raise \$10,000 for that purpose.

KANSAS.

Arrangements have been made to extend the Amity irrigation canal twenty miles in the western part of the State. It is one of the best ditches in the West.

The State school fund has an accumulation of \$208,000. The officials are anxious to invest this in school bonds, but none are offered, and it will probably be invested in United States bonds.

NEBRASKA.

There will be a great many trials of windmill irrigation in the western part of the State this year.

A butter and egg station has been established at Niobrara, one of several along the Milwaukee line.

The Beerline and Smith irrigation ditch, near Hedberg, is completed, and they are counting on full crops this season.

The average yield from the sugar-beet industry in Nebraska is fifteen tons an acre. The producer is paid \$5 a ton. The tops, also, have a value.

NEW MEXICO.

A vigorous horticultural society is promoting fruit culture at Hagerman.

A beet-sugar factory is to be built at Eddy, \$185,000 having been raised for it, of which \$15,000 was a local subscription.

Efforts are again being made for the extension of the Pecos Valley railroad from Roswell to the Texas panhandle, to a connection with the Santa Fé.

The Taos valley, the garden spot of Northern New Mexico, is feeling the impetus from new capital introduced for both mining and ditch building.

The Maxwell Land Grant Company is doing a commendable work in getting out two carloads of cottonwood trees from the lower Rio Grande, to distribute among the settlers along the Vermejo canal.

Three extensive dams and irrigation systems are projected on the Rio Grande river. The International dam, just north of El Paso, Texas, which is to be built in order to insure water to the farmers in the Isleta valley, Texas, and to the Mexicans in Mexico on the other bank of the river, both of whom complain that they have a moral if not a legal claim against the United States for diverting the water higher up on the river, and so depriving the people around El Paso of their water rights. The Mexican government shows a disposition to provide half the necessary capital, and Congress will be asked to appropriate \$1,000,000 as the share of our government. A second dam is contemplated near Rincoe, the capital for which is being sought in London, but so far without success. A third dam is projected near Fort Seldon, and is in the hands of Chicago capitalists, who are making the necessary preparations to raise the

capital. The two latter dams will irrigate the Rio Grande valley north of El Paso, Texas, but as only one will be needed the first one to be built will make the other superfluous.

OREGON.

The K. S. D. Fruit Farm Company is pushing the work on its large farm at Ontario.

A dangerous skin disease has broken out among the Indian ponies near Pendleton, Oregon. It is in the nature of a mange.

Many hop yards are being plowed up in the Willamette valley. Low prices and vermin have made a discouraging combination.

Eastern Oregon stockmen are in rebellion against orders of removal from the forest reserves recently issued from the Interior Department. Immense herds have been feeding there.

UTAH.

The Mormon church property has been restored by act of Congress.

A large acreage of fruit trees is being planted in the Bear River valley.

A railway grade is being made through Provo canyon; nobody knows for whom.

The Bear River Irrigation Company are planning for a large movement of settlers to their lands this year.

Brigham gardeners and fruit growers report an absence of the usual worm pests, and anticipate a large and superior crop.

Sheep men are happy this spring. Their flocks have wintered well, there has been plenty of feed and the fleeces are large and of good quality.

Work has begun in earnest on the great power dam in the Ogden canyon, and the Union Pacific company has put in a branch track to facilitate the delivery of material.

The governor and legislature have memorialized Congress to set apart and donate a portion of the abandoned Fort Cameron reservation for the establishment therein of a State normal school.

Salt Lake City is gratified by a reorganization of the Oregon Short Line and Utah Northern railway, which makes it an independent line with headquarters there, and under the management of a Utah railway man.

Almost an entire section of land has been sold in five and ten acre orchards by the Bear River Valley Orchard Company under a system which insures the delivery of a well-grown bearing orchard at the end of six years. Payments are made in monthly installments and the non-forfeiture plan, first adopted by this company, makes the investment a popular one.

WASHINGTON.

Spokane finds it necessary to curtail the use of city water.

The Spokane Poultry Show was a success financially and as an exhibition.

About seventy-five per cent. of the 50,000 trees that are to be set out in the vicinity of Ranier this season will be prunes.

Robert Scott has plowed up eight acres of hops on his ranch near North Yakima, and will plant 1,000 peach and apple trees, with which he has had great success in the past.

The Walla Walla Water Company has checkmated the city in its plans for obtaining its own water supply by buying the property and rights which it expected to utilize.

The corporation counsel of Spokane says he has 500 cases pending, and is about to commence no less than 2,000 new cases on behalf of the city. He asks allowance for a typewriter. It looks as though he might need more than one.

Professor Harry Landes has been appointed State geologist. The office was created many years ago, but was grossly misused and was abandoned as a dead letter. There is no State appropriation in its behalf, and the university assumes all the expense of an excellent equipment, and the official conduct of the office.

WYOMING.

The flock masters are preparing for the largest crop of wool on record.

Russian wolf hounds are being used successfully to run down coyotes.

A large immigration from Europe is expected in the Big Horn basin this year.

The Cody Canal Company has the first contract that has been signed by the President under the Carey act, for 70,000 acres to be irrigated.

TOPICS OF THE TIME

Forest Preserves. The theory upon which legislation has been enacted for the preservation of forests in many portions of the West has been that by their destruction, either for commercial purposes or by fires, the absorption of the rainfall into the earth is retarded; and the snows melt more rapidly for lack of tree shelter. In a communication to the Fresno Republican, Mr. H. F. Dunnington cites the experience of mountaineers to controvert that theory, and asks attention to the following facts: That the snow lasts longer and is much heavier above the forest belts than under the shelter of the trees; that around and beneath the trees the snow melts and runs away sooner than where there is no shelter from the sun's warmth; that the glaciers and great deposits of snow and ice, which are the chief source of the river supply, are nowhere found within the wooded belts, and there is no eternal snow except where there are no trees. He instances that the valleys of Switzerland are neither burned up by droughts nor swept by floods, although surrounded by vast barren mountains. He maintains that the practice which prevailed during all the past among the Indians of an annual burning of the undergrowth and grass was not detrimental to the strong and healthy growing timber, and that the great injury has chiefly come since short-sighted enthusiasts have interfered to prevent the burning until the undergrowth has become so rank that an accidental fire causes the greater damage. He makes the sensible suggestion that legislation might better compel and direct the planting of new trees for each one utilized commercially. His article offers food for thought and suggests that there are two sides to this as to most questions.

An Unfair Advantage. It is a matter of more than passing concern that the beet sugar industry should be brought prominently to the public attention throughout the entire country. With Cuba's production reduced to almost nothing, and our legislation favoring the

German producers, we are sacrificing one of the greatest opportunities ever presented to our Western people. The irrigated sections are especially interested in this matter. Mr. T. R. Cutler, manager of the Lehi, Utah, sugar factory, was before the ways and means committee at Washington a few days ago representing the sugar beet producers. He made the point that the Germans were gaining an unfair advantage by reason of bounty. It was neither "free nor fair trade," and in his opinion the industry and capital of our country were entitled to protection against it as much as they were against the guns of a foreign nation. Germany was taking advantage of the Cuban war to crush our sugar industry, and he appealed to the committee to recommend an additional duty on German sugar.

Chances for Poor Men. The Idaho Statesman would not discourage the poor man from settling in that State. If he thinks he can see the opportunity to utilize his energy to good effect, he is welcome to come and try. It pertinently suggests that many of the leading men of the future will probably be from those who entered the State short of this world's goods, and who grasp the opportunities which are now presented, as they will not be when the development is further advanced. Look where you will, most of the wealthy men in all Western communities are those whose foresight led them to acquire property at its lowest value, and have seen it grow according to the wisdom of their selection.

Tired of the Treatment. The Cheyenne Sun-Leader, commenting on Secretary Hoke Smith's nullification of an act of Congress, which provides for opening of the Uintah and Uncompahgre reservations in Utah, says:

"The West is getting very tired of this kind of treatment, and unless it is changed there will come a time when the men of the West will not have it any longer. It has reached that point now when they are

asking themselves: 'How much do we owe these Eastern people anyway?' From their mines, the few people in the West have turned a stream of probably five thousand millions of dollars into the coffers of the East during the last forty-six years. When that big stream began to flow the East was so poor that it had no better credit than Egypt. Because of that stream it has become the foremost power in all the world, and in return these Eastern people treat the West as an encumbrance, inhabited by barbarians only fit to be governed by the strong hand of the federal power, and only fit for the work of the earnest missionary. In contemplating it, Western men reflect that when civilization goes to seed, and its utmost exertions are turned solely to making more money, it is worse in its effect upon the world than absolute barbarism."

Fencing In or Out. It goes without saying that if there had been a universal principle by which fencing could be regulated, and laws had been based on that principle, an immense expenditure, in the aggregate, would have been saved to the farmers of this country. The point has recently been raised and good argument presented why the fencing in of all stock kept by the farmer should be the rule. It does seem an injustice that a man should be permitted to let his stock run at large and trespass on his neighbors, perhaps unruly animals at that, and compel a dozen of them to build fences for their protection and his benefit, when there is no other necessity for such structures. If each farmer fenced such fields as he needed to pasture and that alone, and could be held legally responsible for damage caused by his stock he would certainly see that his fences were kept in order, and that the gates should be kept closed. He would have option as to how much land he would enclose, and would build only as necessary. It would involve no more care than is now necessary, and it would certainly require far less fence than is now in use, for which there is not only a large first cost, but a constant annual charge for repairs.

False Economy. The secretary of agriculture is making a hobby of saving money out of the appropriations for his department. He even ventures to ignore the

specific acts of Congress, and, when compelled to execute the law as it stands, does it with the worst possible grace, and evidently with a view to making the seed department odious. Instead of seeking to carry out the law in its true spirit, which would be vastly beneficial to the farmers of the country, he is apparently willing to let his department become of actual disrepute among the people for whose especial benefit it was created, after a long and earnest struggle on the part of broad-minded and public-spirited men.

The Sugar Industry. There are no crops more worthy the attention of our people than are those adapted to the production of sugar, whether cane, sorghum, beets, corn or the maple tree. European countries have been forced to abandon wheat growing because of the low price, and they are finding it to their advantage to encourage, even by liberal export bounties the culture of the sugar beet. Our market absorbs immense quantities of their sugar and it is a pertinent question which hardly permits more than one answer, can they overcome the disadvantages of worn out land, long shipments, and pay the bounties and still derive a greater benefit from that crop than is possible to our own people with our fresh, strong soils, good transportation facilities and improved implements for the cultivation? The answer surely must be a negative.

Good Roads. No subject is worthier of sturdy thought and none of greater practical importance to the farmer than is the improvement of the roads over which he must transport his products. For this he must provide both the vehicle and the motive power. If it costs one dollar a ton to haul over the present soft and badly-kept roadway, there is a saving equivalent to that amount, if the road be put in condition to double the load upon each ton of traffic. A ton of corn to the acre is a fair yield and a saving of forty dollars on a forty-acre field is ten per cent upon four hundred dollars. A road tax for that amount would be startling, wouldn't it? And yet, measured on a business basis, as the banker, merchant, or railroad man would estimate, it would be a good investment. But that would

be only a single item in the account to the owner of a 160-acre farm. If the reader will but compute in his own case the several items of saving in money, time and labor, to say nothing of the satisfaction of driving over good roads and the very considerable enhancement of value to the farm itself, he will find a complete justification for paying twice the amount that will be necessary to effect the percentage of saving suggested.

Gradually Improving. Although the larger irrigation companies whose investments amount to hundreds of thousands or millions of dollars are not yet securing the full number of settlers which their original plans contemplated, and which are necessary to make their investments profitable, there is a steady onward movement which only needs two or three years of normal conditions to bring about a fairly satisfactory situation. The science of practical irrigation is steadily advancing, and each year makes the proof yet more conclusive that it is the most perfect method of crop culture. To the individual farmer, it is almost universally profitable, and it is only necessary to make the company investments equally so that the lands shall be fully occupied. Several of the larger companies have been unable to pull through the long period of depression without such defaults as compelled re-organization, and in nearly every case there has had to be some indulgence exercised on the part of creditors. As a whole, however, the improvement of the situation is encouraging.

Changing Sentiment. It is an altogether erroneous idea that the necessity for irrigation is an objection to agricultural lands. No fruit grower having once experienced the positive advantages which the possibilities for irrigation afford would ever be willing to forego them, and the general farmer will find a positive saving in time, labor and money if he is in position to control the water supply and apply it at his own convenience. From all over the country we get reports of experiments being made within the rainfall area, the primary object being, of course,

to insure against the effects of drought, which though of brief duration often occasions heavy loss. The results of such experiments are generally most encouraging, and those who make them ought to see that the experiment is properly recorded as to its cost and effects, with a view to publication for the benefit of the general public.

Farmers' Institutes. There was never a time when farmers' institutes, clubs, societies and granges were so actively discussing practical topics of local interest and relating to their vocation. The papers, many of which are given a widespread utility by publication, are generally well expressed and indicate careful thought. The preparation of such papers cannot fail to be twice blessed in their influence—upon the writer and reader alike—and it is such study that adds efficiency and dignity to the farmer's calling.

Chauncey Depew Converted. "Irrigation's the thing," says Chauncey M. Depew, after a month's trip through the Western States. Like every one else who once enters the domain of King Water, Dr. Depew was converted quickly and easily, and he has now returned to the East to tell the farmers of that section a few of the "Blessings of Aridity." What matters it if the water does cost something, it's cheaper than fertilizers, and a crop is always assured. More power to the silver tongue of the renowned doctor in teaching the Eastern public of the advantages and possibilities of the Great West instead of the Greater New York.

Garden Luxuries. The farmer who will give just a little thought and care to his garden may have almost every table luxury that is obtainable by the wealthiest. Instead of being the least important feature of the farm it may easily be made the means of the greatest possible satisfaction and comfort for the entire household. More than that there may be berries and fruits of the choicest varieties from earliest spring to the midwinter if the good housewife will pay a little attention to drying and preserving. Don't neglect the garden.

MACHINERY AND APPLIANCES



FIG. 2

D. HILL
Evergreen Specialist
DUNDEE ILL.

EVERGREENS.

The accompanying cut will give a very good idea of the advantage of growing evergreens by the method employed by the Dundee Nursery of which D. Hill, the evergreen specialist, is the proprietor and manager. Fig. 2 shows a Norway spruce as grown under ordinary conditions and without the proper transplanting and cultivation. Fig. 1 shows a tree of same variety and same age, but one which has had the advantage of the special knowledge and treatment of Mr. Hill. Every man who has had any experience knows that the prime essential in the selection of young plants or trees is a strong healthy root growth such as is shown in Fig. 1. A good deep green and healthy color in evergreens, that which is so much prized by growers, can only be imported by an understanding and intelligent course of treatment. Those who wish to buy anything in this line can obtain a catalogue with full description free from the Dundee Nursery, Dundee, Ills.

WATER TANKS.

In a climate like that of California, where it is dry eight months of the year, dripping water tanks are a common spectacle as to excite but little comment except by those who have the care and expense of keeping them in repair, says the Pacific Rural Press. And this is no small item, where tanks are generally used. The cause of the trouble can nearly always be attributed to shrinkage of the staves when the water is low. This necessitates driving down the hoops, requiring constant attention and expense, also damaging the tank, to say nothing of the loss of water. It is seldom possible to keep a tank full all the time and they frequently have but little water in them. Consequently the trouble is common. To overcome this, the Pacific Tank Company is manufacturing, at its works on Channel street, between Sixth and Seventh, San Francisco, a patent "non-shrinking" tank. This tank is made with a deep channel or groove in the top of the staves. This groove is filled with water from pump discharge, which, by absorption, passes into the pores of the wood, keeping the entire tank moist at all times and preventing shrinkage. A catalogue will be mailed on application if you mention THE IRRIGATION AGE.

CARRIAGE CATALOGUE.

A very handsome and elaborate illustrated catalogue of Buggies, Surreys, Phaetons, Farm Wagons, Road Carts, Harness, Saddles, and Horse goods, showing a great variety of styles and shapes, has just been issued for 1896 by the well-known Alliance Carriage Co., of Cincinnati, O. This enterprising company prints the prices in plain figures (factory prices) in their catalogue and send goods anywhere subject to examination. Any horse owner can have a catalogue free if he mentions THE IRRIGATION AGE.

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VOL. IX

No. 6

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"	15	1 $\frac{1}{4}$	$\frac{3}{4}$	6 " 12	5	8	150	55 00	70 00
"	20	2	1	8 " 16	7	2	200	60 00	75 00
"	25	2 $\frac{1}{4}$	1	10 " 24	11	2	225	65 00	81 00
"	30	3	1 $\frac{1}{4}$	18 " 36	11	2	250	75 00	90 00
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THE IRRIGATION AGE.

VOL. IX.

CHICAGO, JUNE, 1896.

NO. 6.

IRRIGATION IN VICTORIA, AUSTRALIA.*

CHAPTER I. GOVERNMENT AID. FORMATION OF DISTRICTS.

BY OUR SPECIAL CORRESPONDENT.

SOIL eminently suited to the growth of cereals and fruit trees is found over a large area in Victoria where the climatic conditions are unfavorable. The average annual rainfall varies from seventy inches on the coast ranges to nine inches over the northern and western plains. The fine sunshine and dry air of these interior plains are well adapted to mature fruit to perfection, but the deficient rainfall makes fruit production uncertain. To render producers independent of rainfall and to enable them to make the most of the soil at their disposal, irrigation trusts have been formed, a brief description of which, with a more detailed account of one or two as types of the east, may be of interest to your readers in America. Victoria is divided into two portions by a high range running generally east and west. The humid air currents from the south deposit their moisture on this range, thus forming a large gathering ground, from which are fed numerous streams which run north to the Murray River, the northern boundary of the colony. The plains to the north of the divide are thus deprived of much of the rainfall, which under other physical conditions would have been deposited on them, but in compensation have ample supplies of water running through them in the form of streams sufficient, if properly conserved and directed, to furnish all the moisture necessary for the production of cereals and fruits. To this conformation of the country is attributable the fact that the majority of the trusts are situated near the northern center of Victoria.

*All rights reserved.

Prior to the formation of the trusts private owners of property had erected windmills or provided small steam plants, for raising water for stock, and incidentally for irrigating gardens and small areas of crop, etc., but it was not until 1881 that the Victorian legislature passed an act authorizing the constitution of water supply trusts. This provided that nine councils, into which the colony is divided for the purpose of local government, could form themselves into such trusts, subject to the approval of the government from whom they could borrow money necessary for the works, repaying principal and interest by the revenue received from rates levied within the area under their control.

The trusts formed under this act were not only for agricultural and horticultural purposes but also for providing water for stock, for which purpose existing water-courses and depressions were made use of, to fill which, water was conserved at convenient places and permitted to run into them at stated times during the dry season.

VISITED AMERICA.

The bill was found to be only partially successful and was amended in succeeding years, until at the close of 1884 a royal commission was appointed "to inquire into the question of water supply and into other matters relating thereto." The chairman, Mr. Alfred Deakin, member of the legislative assembly, visited America for the purpose of studying irrigation in its latest application, and information was also obtained on the subject from various countries of the old and new world.

The result was a valuable report upon which was based a comprehensive measure, called the irrigation act, 1886. This provides that any district, upon application to the executive government, giving plans and full particulars of the proposed scheme of irrigation and water supply, including cost, maintenance, probable revenue and necessary rating power, may be constituted an irrigation trust, provided that the opposition to the scheme in the proposed district is not greater than a specified minority, and provided that the minister and chief engineer of water supply report favorably on it. The government having approved of the application the scheme has then to be laid before parliament with all documents, etc., relating thereto, for its sanction. A specially authorized loan is then granted to the trust from a fund specially set apart for the purpose to enable the necessary works to be carried out. A small rate of interest is charged and a sinking fund provided to extinguish the loan. It is also enacted that certain portions of a scheme may be denominated "national" works and paid for solely by the state; or "joint" works, payment being made by both state and trust; or "trust" works, for which the trust alone is responsible.

The trusts are managed by commissioners elected by ballot of the ratepayers in each district, who have full financial control and responsibility in connection with the undertaking, and who appoint the necessary officers for carrying out the works and controlling the supply of water.

Great facilities were thus afforded to districts in which the rainfall was deficient of obtaining an adequate supply of water. The value of this boon was soon recognized, no less than thirty trust districts having been formed since the passing of the act, comprising a ratable area of 2,700,000 acres, to which advances have been made by the state to the extent of £974,000 or about \$4,870,000. The total sum authorized by parliament to be lent to the trusts is £1,364,000 (\$6,820,000). In addition the State has expended the sum of £799,000 (\$3,995,000) on national works, thus the total amount advanced to and spent on the behalf of irrigation trusts is £2,163,000 (\$10,815,000).

AREA IRRIGATED.

All the acreage mentioned as conferred

in the first district is not irrigated although ratable. Some of the schemes have been allowed to lapse and several are merely commenced. There remains, however, fully 1,300,000 acres which may be brought under irrigated culture when all the schemes are in full working order. The annual returns to end of 1895 given by the department of water supply show that 76,600 acres have been watered during the past year. Of this total, 30,000 acres consisted merely of grass, 20,000 acres of cereals, and not more than 2,900 acres of vines and fruit trees; the balance being made up of lucern, vegetables, flax, maize, tobacco, etc. This leads to the conclusion that the expenditure has been much in advance of present requirements. That this is so is also shown by the fact that the returns to the state in the shape of interest for money lent is greatly in arrears, the sum outstanding exceeding £160,000 (\$800,000).

In many cases the trusts saw no more than the advantages likely to accrue to their districts through possessing a sufficient water supply, and did not consider seriously enough the large liability they assumed for the repayment of principal and interest of the loans they had received from the government, or if they did understand the position they probably relied upon the leniency of their creditors to postpone the day of reckoning until it was quite convenient for them to pay up. Further, at the outset few knew anything of irrigation in a practical way, and especially were they ignorant of the large expenditure necessary to bring land into a fit state to be irrigated. When it is considered that most of the land included in the trust districts is held in blocks of at least 320 acres, it will be seen how large an amount would be received before any considerable area could be utilized for "intensive irrigated culture." The result has been that the available water has not been made use of to anything like the extent contemplated when the schemes were first proposed. The situation, indeed, had become so serious in 1894 that a royal commission was appointed to investigate the affairs of the various trusts, and make recommendations for this amelioration. This body has not yet completed its report.

The methods of rating are not yet uniform; in some trusts each acre is rated

the same, in others there is differential rating according to distance from the channels. According to the water act, 1890, which consolidated previous statutes, and therefore superseded the Irrigation act, 1886, all water used for irrigation purposes must be paid for by measure, but for watering stock and domestic supply, payment may be made as the commissioners of the trust direct. For irrigation therefore a rate of either 6d per inch, 6d per inch per acre or 1d to 2d per 1,000 gallons is charged in addition to the general rate which varies from 1 to 3 shillings in the pound of actual value.

Looking at the present position of the irrigation scheme in this colony, although the expenditure was at the outset on a scale far too lavish for the limited population likely to avail themselves of its ad-

vantages, still there is no doubt but that the value of the land within reach of the water channels has been largely increased, and it has been made evident that by means of an artificial water supply the arid plains of the interior are capable of supporting a very large population. With an arrangement to relieve to some extent the heavy liabilities lying upon the trusts, and an increased settlement of people on the land, which such an arrangement would facilitate, the future of irrigation in this part of the world is by no means gloomy. We are a young colony, both enterprising and sanguine and not to be dashed by the clouds of temporary depression, as the returns of our exports clearly prove.

In future papers, some of the more important trusts and their works will be dealt with in detail.

IRRIGATION BY PUMPING.

THE RECLAMATION OF THE GREAT PLAINS. "A WAY OUT."

BY H. V. HINCKLEY, C. E.

FIFTEEN to twenty years ago, when Providence smiled upon the Great Plains to the extent of thirty inches, or even more, of rainfall, immense crops were grown wherever anything was planted, for the richness of the virgin unwashed soils needs only water and labor to speak miracles to the New England agriculturist. But the newcomers who depended upon such annual rainfall being furnished by Uncle Sam along with the land titles were disappointed and a million homesteads have been abandoned which with water would produce bountifully. Many cities (real cities which had hotels, banks, etc., ten years ago) are now marked only by cellar holes and corner stones. These are blue statements, but they are facts. As in all arid or semi-arid countries since the beginning of history so in Western Kansas and Nebraska, for example, a lack of appreciation of the need and advantages of an artificial water supply has resulted primarily in destitution and depopulation.

The densest populations of the world

have been founded upon irrigation agriculture, but they irrigated only when they had to irrigate to live, and only then have they been aroused to a realization of the immense benefits, the profits accruing therefrom. Under the new order of things some of these abandoned homesteads are already becoming valuable. It will not be possible to irrigate all the plains country. Probably between fifteen and thirty per cent. of the area can be finally brought into successful agriculture. The irrigable per cent. varies from none on some divides to one hundred in some valleys.

Land values in the Arkansas and similar valleys having an abundant and reliable underflow are bound to advance, while the high lands without water must be devoted to alfalfa and cattle.

Alfalfa is a very deep rooting clover that responds handsomely to irrigation, and yet lives and produces fair crops where all other grasses fail—where water is at a premium. It is already being extensively and successfully grown even without irri-

gation on quite high lands. It frequently nets \$15 to \$40 an acre above all expenses, and needs but little attention except at harvest—three to six times a year; the average net income officially reported by Finney county, irrigated and unirrigated, being \$21.45 per acre per annum. The plains need pumps and people in the valleys and cattle on the high lands.

The plan of the Alfalfa Irrigation and Land Company of Topeka may be cited as presenting the writer's ideal of the correct "Way Out" for the Great Plains.

comers (each tract to have its own pumping plant) and into sugar beets and alfalfa for hogs and cattle. Thus will the present unfortunate land owners realize upon the productive value of their investments instead of paying taxes and getting no returns.

Capital will do the developing, but each irrigator will be independent.

The handsome profits on alfalfa have brought forth from the conservatives the cry that the supply must soon be greater than the demand, and prices and profits must go down.

L. L. DOTY'S CABBAGE PATCH, IRRIGATED.

WHAT IS BEING DONE.

Lands are being secured from non-residents, to whom they are without value, in exchange for capital stock, the higher lands at nominal figures, for their pasturage value can not exceed \$1 or \$2 per acre, and the valley lands at figures depending upon local demand. The high lands are to be consolidated and fenced as large pastures with an occasional quarter of alfalfa. The valley lands are to be pump irrigated and put into small orchards and vegetable gardens for new-

A company that feeds its own alfalfa to its own cattle and hogs and gets a hundred pounds of best beef for the Lords of London from each ton of alfalfa, can regulate its own demand and supply and obtain spring instead of fall prices. In the corn belts of Eastern Kansas the cattle are "finished" for the Kansas City and Chicago markets, which handle five million cattle and ten million hogs annually.

The era of the dry farming lottery is passing. Crops are no longer scratched

ALFALFA STACKS.

in upon unbroken lands by the square mile, but are being planted, subsoiled and watered, and are yielding surely and abundantly. A maximum crop beats a stunted crop. A maximum crop every year beats a fair crop occasionally, when the rain happens to fall just right.

Irrigation is the only insurance that provides against droughts, hot winds and frosts and that pays to the policy holder annually the full face of the policy and pump irrigation is the most reliable of all.

COST OF IRRIGATING VALLEY LANDS.

Millions of acres of valley lands now held at \$5 to \$12 an acre, having under them the most reliable of all inland water supplies, can be supplied with pumping plants at \$5 to \$10 an acre, and can be irrigated with an annual expense of \$1 to \$5 an acre (power, repairs and interest), and be made to pay ten per cent. net on \$100 to \$200 per acre, and often several times these figures. The pump irrigator is free from monopoly control of water, from canal and reservoir management and from the vexatious and costly delays resulting from water supply uncertainties and canal failures. He erects his own pump on his own premises, pumps his own water into his own reservoir, irrigates at his own pleasure, and does his own superintending and adjudicating.

While the millions of acres of high lands must be devoted mainly to alfalfa and cattle, the man who is fastened there by other business than farming can, by pumping water, grow at least the garden produce necessary for family consumption and perhaps sell some to his neighbors.

For each locality and for each size of farm in each locality there is but one style of plant, one kind of pump and power and one size of reservoir that results in the best capitalized pumping investment and, while the writer has been collecting and tabulating data on this subject from experiments and actual results on high and low lands for two and a half years, the relative merits of the various pumping plants is intentionally omitted from this article.

While the purchasers of high lands on the plains, "unsight and unseen," are losers, I am convinced beyond question that lands in the Arkansas valley or any other valley having as reliable an underflow, are among the best investments in the country at present prices. They must be worth \$50 to \$100 an acre when supplied with pumps and people; and when the water supply and the cost and advantages of pump irrigation become better understood, the valleys will be continuous gardens, vineyards and orchards; the high lands will be pastures of native grass and alfalfa. In British India three million acres are irrigated with water pumped from wells. In the United States of America, and not alone upon the plains, pump irrigation is in its infancy.

[NOTE. The author requests us to state that the photo of the Waymire reservoir on page 190 and the reference thereto on page 186 were inserted by us without referring the matter to him.—Ed.]

DITCH FROM FRIZELL'S RESERVOIR.

IRRIGATED APPLE ORCHARD IN KANSAS.

THE ART OF IRRIGATION.

CHAPTER XIII. THE GREAT FLOODING SYSTEM OF THE
SAN JOAQUIN VALLEY.

By T. S. VAN DYKE.

THE immense scale on which water is handled in the great central valley of California is worthy of a special study because there is no other place in the United States, and probably not in the world, where water is so intelligently used in such vast quantities on so large an area. At the same time the methods cannot be recommended in all respects for the small farmer, though for extensive work with plenty of water at command they are hard to improve upon.

Kern River, draining the lofty country south of Mount Whitney, rolls out upon the great plains of Kern County over two

thousand cubic feet average flow for the dry season, or over one hundred thousand miner's inches. This is generally much increased when the snow is melting, making the summer supply very large and reliable. This with the winter flood-water once made about a quarter of a million acres of shallow lake and swamp covered with reeds and tule and willow bordered sloughs, exhaling all summer long a malaria almost as deadly as that of Panama. Bordering this on the east side of the valley were half a million acres of fine granite soil drifted in the course of ages from the hills and lying on a slope

of about fifteen feet to the mile though looking level as a floor. No finer soil for all around purposes is to be found in America; but twenty years ago it was the most hopeless of all deserts, for the average rainfall was a trifle over four inches, the Coast range on the west and the continuation of the lofty Sierra Nevada to a junction with the Coast range on the south, cutting off most of the winter rains.

The same stroke that would turn the waters of the river upon this arid land would reclaim all the swamp which was the richest soil imaginable. But it was a job no state would undertake, and it was absurd to expect private capital to build canals in such a country and wait for settlers. The few jaundiced hog-and-hominy settlers that lived by fiddling and fighting along the river and claimed all its waters could not even handle the river so as to take out enough for themselves.

Messrs. Haggin, Carr and Tevis had the desert land act passed, it is said, so that that they could grab this land. If so they deserve the thanks of California, for it has added a rich county that would otherwise have raised little but scenery, dust and malaria. They spent some twelve millions of dollars in building canals of which there are now twenty-seven. The diversion of the water brought on the great riparian suit with Miller & Lux, who were very wealthy and were attempting to drain out the swamp below so as to take that under the swamp and overflowed land reclamation act. It is said that litigation cost each party nearly a million of dollars. The total cost to both parties could not have been far short of that. The outcome was a compromise by which Buena Vista Lake, a shallow lake covering over a township, was turned into a reservoir. By this the entire flood flow of the river is stopped, the canals taking all the ordinary flow. It now covers twenty-seven square miles to an average depth of ten feet, making a store of water which hardly shows the great draught for Miller & Lux's immense farms below. Thus was added to the state more water than was then held by all its other reservoirs combined. As I hunted ducks over these immense properties last winter I remarked to a friend that there were two sides to the monopoly question.

Miller & Lux have under this water

over one hundred thousand acres mostly reclaimed swamp of which over twenty thousand are now in a solid block of alfalfa. The Kern County Land Company, composed of Tevis, Haggin and Co., have under the ditches on the dry side some four hundred thousand acres with one patch of about thirty-five thousand acres of alfalfa.

The difference between this reclaimed swamp and the land that was once desert must be kept in mind on account of the different ways of irrigating hereafter mentioned. On the reclaimed swamp, which is a black muck of tule roots running into peat in many places, the level of the water below is from eight to ten feet. On most of the upland reclaimed by the ditches it is from sixty to almost as much more as you wish.

The method of preparing the land is the same in both cases. The slope is so nearly uniform that on the greater part there is no leveling. Where it dips into swales or old dry slough beds it is terraced roughly with scrapers to very nearly a level, the shape and size of the terraces varying continually with the contour and dip of the land. No rule is followed except the uniform method of having one check enough below another to permit the rapid emptying of the upper one into the lower one if the water is to go there at all. They vary from half or quarter of an acre up to five acres or even more, and though they look like a set of plats running through all shapes from the crescent to a square they are really terraces.

LAYING OUT THE CHECKS.

On the land having a very even slope the checks are almost invariably made on contour lines laid out with an engineer's level. Starting at the upper side of the field the level is swept around and stakes set every few yards on a line about a foot below the instrument. If the slope is uniform the line of stakes will be a crescent and will vary from this in all manner of wavy curves according to the change from a regular slope. The level is then moved down to the line of stakes and another line of stakes set below that, care being taken not to leave ends or horns on the crescents in which the depth of water could be too slight. Rather than do this the shape is changed and a square or

other figure thrown in between true contour lines.

As thus run, some of these check lines are nearly a mile long. The checks thus formed run from about twenty acres up to two hundred with an average as near as I could judge of about forty acres. Near Pozo, in Kern County, are several thousand acres laid out by the eye by a Chinaman who was an experienced irrigator. I saw it under water and it was well enough done, so well done that I am certain that with a carpenter's level fitted with rifle sights and a common tripod any one with sense enough to take the height of the instrument on a rod marked plainly into feet and tenths of a foot, and with enough arithmetic in his head to add or subtract the readings from the height of the instrument, could lay out any ground well enough for good flooding.

The embankments made on these lines vary in height from fifteen inches to twenty or even twenty-four inches, the average being nearly eighteen for the central part of a whole line so as to allow a foot of water behind it with no danger of its being breached by wind or defects. At the lowest point the water is often deeper than a foot and at the shallowest points much less, but the general aim is to have it everywhere as near a foot in depth as possible though it by no means follows that that amount of water will be run into it at every irrigation.

At the bottom these check lines are often as much as eighteen feet in width though twelve to fifteen feet are more common widths for the high parts. They are round upon the top with both sides on such a slope that any kind of machinery can be run over them and cut anything that grows upon them as well as if it were on the level. The alfalfa, grain, or whatever is in the field is planted upon them the same as in the bottom of the check and, as far as can be seen, grows as well.

At the lower part of some of the checks is a large gate in the embankment large enough to discharge the water quickly into the next check below. But in most cases the reliance is on cutting with a hoe. It is conceded by the superintendents that the gate is much the better and in the long run probably more economical, though more expensive at first.

These embankments are made with a

buck scraper or a Fresno scraper and are too large to make with a common plow in any case. With a movable moldboard about ten feet long a common plow may be used to make them if they are not too large. But this makes a heavy drag and for some of the largest checks takes ten horses in heavy soil. In place of the moldboard five or six revolving disks like those on the disk cultivator are set on an axle eight or ten feet long inclined according to the slope and the whole fitted to a well braced frame of a Stockton Gang Plow. One of these was being tested the day I was there and I saw four horses do the work of eight with it in throwing up a ridge, the whole difference being in the friction of the solid moldboard, the disks turning over instead of resisting. A slip scraper or any kind that bounces will be too slow to do such large work economically. Even the machine above described must have broad wheel-braces rolling against the face and bottom of the cut to relieve the extra friction, or more horse flesh will be needed at once. All this would be too expensive for a small farmer, but for flooding on a large scale it would pay any one to begin checking in that way.

It must be remembered that there is plenty of water here and some things are done that might be inexpedient elsewhere. If you are sure to have water to fill them it is best to have the checks high enough, provided your soil or crops will stand a considerable depth of water. But if you have not the water or have it in heads too small then your high checking is useless expense. The depth of water you may put in a check will depend not only on the soil and the crop, but greatly on the length of time you hold the water in the check. This you should determine in advance by experiments on a small scale if your neighbors' places will not show what it will do. Under the hot sun of the San Joaquin summer, alfalfa will often scald in less than three hours, and if the irrigating water is very warm two hours are none too safe on some spots. Hence the water must be put in and let off quickly. But unless the soil is porous enough, too great a depth of water will puddle it and retard the soaking instead of hastening it, and if porous enough to be wet more quickly by greater depth of water then you must have a considerable

depth so as to leave water to run into the next check. For on this big scale laterals cost money and it is strict economy to make one check feed the next one for a pretty long series.

Checks thus made will last practically forever, the alfalfa or grain preventing their washing. They become in time as hard as any canal bank, and the only weak spot is the place where they are cut. This is purposely left weak to avoid the labor of cutting every time which is considerable where they are of full strength.

TURNING IN THE WATER.

When all is ready to turn in the water, eight or ten men, armed with hoes, take a line of checks, and a head of about thirty cubic feet a second or 1,500 miner's inches is turned into the upper one. If a large one, there is considerable waiting to do, but if a small one it is not long before it is time to cut the lower bank to let the water into the next one. In a small check one cut is generally enough, but in a long one, two or three, and even four cuts, may be necessary to empty it fast enough. These cuts are quite large and let a great volume of water through. Ten men can handle this head of water and irrigate 200 acres a day with it on an average. Generally seven can do it, unless there are a great many small checks to fill and empty. Where they are very large two or three men can do it, and there are places where one can do it. There a single man on the line of bank between two checks of 200 acres each reminds one of the old hymn—

"Lo, on a narrow neck of land,
Twixt two unbounded seas I stand."

I tried to get a picture of one of these, but it is too large for a common camera to bring out well.

At the rate of one man a day to twenty acres this is very cheap flooding, and it can hardly be done on the scale requisite for good orchard work, to be followed by cultivation. For the only safe way to do that well is to make the checks small and have the water shallow in them. For handling these with a head of two cubic feet to ten acres, two and generally three men are necessary for very good work. A piece of land so flat that ten acres can be managed by one man on a small scale is not likely to be well enough drained to be good orchard land.

Sometimes enough water is at once let

into the upper check to feed the whole line of which that is the first, and sometimes more water is allowed to run through it to add to the first instalment. This depends on what is in it and how it will stand the run of water; old alfalfa standing a good deal if there is no danger of scalding. The whole is so arranged that any surplus at the lower end has a waste ditch to receive it.

When these checks are emptied plenty of wet spots remain, with water an inch or two and often three or four inches deep. These are depressions which it was not thought worth while to fill by leveling off the tract. Probably the results would not, for low-grade crops, justify the expense where land is so plenty and water so cheap. But this will not do for the small farmer to imitate, and the effects of it can be quickly seen even in winter, when the sun is not hot enough to scald the plants or to bake the ground much. Of barley, wheat and young alfalfa about one-third of the stand is destroyed by a depression of about two inches, and about two-thirds by three or four inches. In some places where the water had been so deep that it was impossible to make an estimate, it was practically all destroyed. That is, if the whole field were in that shape it would be too thin to be worth cutting. Old alfalfa seemed uninjured. There was no grain old enough to show the effect on old grain, but it would not have been as bad as with the young grain, though anything but good. In hot weather the effect would have been much worse. It is due principally to the water standing too long and deep. On account of the pressure it would take the water that remained in the depression much longer to soak away than if that were all that had been put in there in the first place.

Smaller checks, and especially square or rectangular ones, for lands lying like these and bearing such crops, on so large a scale, would merely increase the cost without any corresponding advantage. The larger they can be made the greater area a given number of men can handle, and the only limitation on the size is the depth of water in them and the facilities for getting it quickly in and out again when it has done its work.

There seems no doubt that all this work is profitable. Miller and Lux are not offering any land for sale, yet they are

constantly increasing the area in crops and making new canals, and laterals by the league, that in most countries would be respectable canals. They have 200 men in constant employ, and have a thousand or more during most of the summer, with many more in harvest. The whole is in charge of Mr. Miller, who is one of the best business men of America. In forty years the firm has risen from poverty to the largest land owners and cattle owners on the coast, if not in the world, their present holdings being estimated at 200,000 head of cattle, with sheep beyond the knowledge of even themselves, and 2,000,000 acres of land. The business has all been built up by Mr. Miller, whose principle has always been to make everything pay. It is therefore safe to assume that this handling of the water and land is profitable on a large scale, though it might ruin a small farmer. Even at the present low price of wheat, the superintendents say there is still a profit in it on this land, and there were some 8,000 acres already seeded when I was there, with more going in.

On the lands of the Kern County Land

Company 800 men are employed the year round, with an increase of thousands during haying and harvest. Though their land is for sale in small tracts, the gigantic scale on which they are farming the rest shows that the owners, who are also shrewd business men, know what they are about. They have also been at it long enough to find out, and are certainly not working eight or ten townships to make a show to sell out on. And the fact that thousands of acres of their lands are rented out to grain farmers whose long strings of teams and plows dotted the great plain for leagues, renters who are no tenderfeet at the business, makes it pretty safe to say that there is here a fair profit in raising wheat by irrigation, even at the present price. About the profits of the alfalfa, even at the low price of beef, there is no possible question, one acre carrying an animal the year round and in summer fattening five, while the constant trampling of the herds seems to have no effect upon the stand of alfalfa, which would be quickly injured if water were scarce or stingily used.

IRRIGATION IN NORTH DAKOTA.

BY W. W. BARRETT, STATE SUPT. OF IRRIGATION AND FORESTRY.

AS THE IRRIGATION AGE is the representative journal of the Union, especially of the West in the matter of Irrigation and Forestry and kindred subjects, I feel at liberty to speak through its columns of these things as they pertain to the commonwealth of North Dakota.

Water is of paramount importance in the economy of nature, especially in its operations in the production of grain, grasses, fruit and vegetables, and during the last few years this subject has received much attention throughout the world. This applies in a specific sense to the western portion of the Union and North Dakota has kept pace with the great advancement. Having been a resident of the State when a territory, until the present time, and having taken an active interest in its development, I can speak understandingly upon this point. The first public movement was made November 2, 1889, at the Irrigation and Forestry Convention at Devil's Lake, Ramsey Co. From that day to this these two subjects have been con-

stantly before the public. The agitation has been carried on through mass meetings, proper handling by the press, legislative discussions, and reports from this department. Thus a marked and healthy public sentiment has been developed favorable to these two great and most important factors. And the results, though not what the most sanguine might desire, are of a practical and beneficial nature.

The progress made is indicated by the encouragement given by the press in the discussion of the subjects, the favorable laws passed by our Legislative Assembly, and the approved work of this branch of the state service, and also in putting the theory into actual operation in the sinking of artesian wells for various purposes. Besides establishing and maintaining the office of state superintendent of Irrigation and Forestry, our code contains some of the best laws in relation to irrigation which can be found in the west; all clear, concise and fitted to the water and irrigation conditions of our state. Proper provisions

are made for the bonding of townships for the sinking and maintenance of artesian wells. New artesian wells are being put down from season to season and the operations of the wells are satisfactory.

In all the Western States some persons are found who contend irrigation should make greater strides; the same is true of our state, but there is a constant steady gain, as a rule, throughout the different states which is a sure evidence of future practical advancement and the fullest material benefit. The proper use of water for producing the largest crop and the greatest profits in the cultivation of the soil is destined to constitute, as is now the case in some localities, one of the chief elements of our western civilization, and the trend of events point unerringly to this most desirable end.

We have in North Dakota 673 flowing artesian wells, twenty of which are deep-seated and the balance shallow wells. The shallow wells are from 100 to 200 feet deep, and the cost of construction is small. The deep-seated wells are from 800 to 1,500 feet deep, and the cost is governed much by the nature of the various strata, size of pipe, etc.—about \$3 to \$4 per foot. The flowage varies. I name a few sample wells:

	Gals. per minute	Lbs. per Sq. inch
Jamestown (City).....	460	97
Oaks.....	817	125
Ellendale.....	700	115
Grafton.....	600	12

All water healthful and some of it soft. Artesian wells are located from the extreme eastern to the extreme western line, and

from the southern to the northern border, and in the eastern central part of the state. The one on the extreme western line is located at Madora on the little Missouri river. It is a characteristic well, 800 feet deep with a good flowage of soft water. The one at the northern line is situated at Delorane, Manitoba, close to the northern border of the Turtle Mountains, nearly twenty miles from the international boundary line that runs through the wooded mountains. This fine, heavy flowing well gives evidence that the artesian deposit underlies the Turtle Mountain district. We have numerous artesian springs in North Dakota. One at the southern edge of the Turtle Mountains give a flow of 283 gallons per minute. There are others having as large a flowage.

The Dakota Artesian Basin is the largest in the world, and it is located in North and South Dakota, in both of which states its waters are developed. Much interest is taken in South Dakota in artesian irrigation, and its application there has proved to be most successful and remunerative to the irrigators in the raising of agricultural productions.

During the last year a strong sentiment has been manifested in our state to make an extended application of the waters of our great artesian basin for agricultural purposes. The State Immigration Convention, held at Fargo, North Dakota this season, pronounced in favor of a governmental survey of our artesian deposits, and urged their development and use by the people in their agricultural pursuits.

IRRIGATION PROGRESS IN NEBRASKA.

By I. A. FORT.

IRRIGATION is applicable to all sections of the United States. There are times, even in those sections where the rainfall annually exceeds fifty inches, that if the plants of the farmer could only obtain a few refreshing drinks, the yield would be doubled. The plant is like a strong team that has been checked in its progress; that cannot reach the point that would be attained because water is not at hand at the proper time to supply the animals in order that they might go on. The plant has, like the average of the horses,

cattle and other animals of the farmers, a period of growth, and when that period is reached the growth stops. Irrigation enables the plant to travel steadily onward. The coming farmer in America will in a majority of cases irrigate or feed his crops; they will be fed with the same care as the successful cattle or hog raiser feeds his stock. Irrigation will restore the worn out fields of New England and the South, and it will reclaim the lands now abandoned in many portions of America.

Water is not only a powerful fertilizer, but it also promotes the disintegration of soils, thereby liberating the elements necessary to the growth of plants. Place upon certain soils fertilizers of certain kinds, and leave them to be acted upon by the chance rainfalls that may occur, and frequently three-fourths of the best elements in these fertilizers are lost through evaporation or seepage. Irrigation can prevent this, and the gain that will accrue through the additional effect of the disintegrating power of the water will be very great.

They have been irrigating in Spain and Italy for centuries. Biblical lands, once under the dominion of the Roman Empire, held and maintained a vast population through their systems of irrigation. Their magnificent works were allowed to decay and the country became depopulated. The Americans now in Arizona are restoring and have now restored irrigating canals that once fed and maintained a heavy population.

Through a system of irrigation lately adopted in Louisiana, rice crops are successfully grown on elevated bench lands that lay above the stream and river. It was formerly necessary to grow this crop in swampy land that could be easily flooded. Now the water is lifted by centrifugal or other kinds of pumps, the land flooded and the crop grown. The land is drained and the rice cut with a harvester, the same that is used to harvest wheat in Dakota. With their sixty-four inches of rainfall annually the Louisiana farmer finds it advantageous to irrigate his oat and corn crop.

Of the States that have actively taken up this question in the last three years, we find Nebraska leading. Canals have been constructed, or are now under construction, that will irrigate over a million acres of her surface. The cost of these canals for their irrigating capacity does not exceed in the great majority of cases over \$2 per acre.

Nebraska is now rapidly following her sister State of Kansas in the erection of thousands of the new irrigation windmills. These mills have from four to five times the power of the old farm pumping mills of the same size. The best practical illustration of the difference in these mills is seen upon the farm of Wm. Stafford, of Big Springs, who had at work in 1894 three 12-foot and one 14-foot farm mills.

In the spring of 1895 he placed in position a 12-foot irrigation windmill attached to a 12-inch direct-acting irrigation pump. All the mills pumped the water into the same reservoir, and from the same depth. The 12-foot irrigator, so Mr. Stafford says, pumped more water than the other four. Where windmills are used, reservoirs are always constructed so that a good supply of water may be obtained, in order that when applied it may be conducted rapidly over the fields. So important is this attachment that a mill that will only lift water sufficient to irrigate one or two acres, will with the reservoir irrigate ten or twelve.

Reservoirs are easily and cheaply constructed; they are made by throwing up embankments of earth to the height of from six to eight feet, then the water is pumped in and cattle or horses are turned in and driven about until the bottom and sides are thoroughly puddled, sometimes heavy clay is hauled from some clay bed or bank and thrown over the bottom and sides. Again, the farmers hitch their horses to a drag or scraper and drive the team around within until the bottom and sides are securely packed and made water tight.

Some farmers in Nebraska have attempted to utilize about all that can be obtained from mills and pumps. The water is first run through the creamery box, thence through the watering trough in the stock yards, thence to the first reservoir from which they intend to cut their ice in winter, thence to a second reservoir where fish are grown, and often a small bathing house is set upon the edge of this reservoir where the youngsters of the family can disrobe and bathe during the summer season. On some of these miniature lakes small boats are found where the youth of the family can commence training preparatory to a more extended course at Harvard, Yale or Cornell. Pond lilies are planted in some in order to check the evaporation. The cost of these irrigation plants is not great where the water is not lifted to any great height, the cost varying from \$4 to \$6 per acre per the irrigating capacity of mill and pump where water is not lifted over sixty feet, yet plants are doing good work and irrigating as high as ten acres, pumping from the depth of 150 and 200 feet both in Kansas and Nebraska.

THE PIONEER IN THE RAISIN INDUSTRY.

LESSONS FROM THE LIFE OF A CALIFORNIA FRUIT GROWER.

By FRANK S. CHAPIN.

BY exaggerating the real evils of farm life, and dwelling upon imaginary ills there has been caused a congestion of population in cities, abandonment of farms and consequent decline of citizenship and public prosperity.

Not all farmers are wrecks from other trades cast upon the shore of that calling where it is thought that any one can make a living, nor do all weary the body, dwarf the brain, and bury the soul in the treadmill of daily toil.

The California farmer who would avail himself of the wondrous possibilities offered by our climate and conditions must be a close student of the alchemy of nature, and to attain the best results must have a broad conception of the laws of trade.

He who visits the home of the late Dr. Blowers, of Woodland, California, will not wonder that Mt. Vernon had such charms for Washington or Ashland for Clay. In view of the importance of elevating productive industry as a means of increasing public prosperity, it is a question whether equal talent devoted to the creation of model houses at Mt. Vernon and Ashland and to spreading knowledge calculated to awaken like aspiration in others might not have been as useful to the country as the wonderful careers that those great men lived.

In 1851 Dr. Russell B. Blowers came to California and like other professional men began mining. After three years he bought a small farm in Yolo County, and soon moved to a larger one four miles south from Woodland. After farming a quarter section for ten years he concluded he had too much land and moved to the eighty acres near Woodland which he afterward developed to such a high state of cultivation.

In 1857 he began to raise grapes, and in '63 he secured from an importation by Arpod Harazthy, the famous muscatella Gordo Blanco grape with which his reputation as the "Father of the Raisin Industry" was founded. In 1868 he began

under an oak tree to pack raisins for market and steadily improved until he was able, in 1876, to take first honors at Philadelphia in competition with the world.

He was the first to introduce the form for packing London layers whose movable bottom enables the packer to face in such a way as to present a perfectly even surface to the eye. He was the first to introduce fancy printing to compete with the Spanish style of packing.

In 1875 he had a car-load of raisins caught in a storm and cured them in the Alden evaporators at Vacaville. That machinery was calculated for curing fruit at high temperatures, but his experience there suggested the principle to him upon which his invention of next year was founded. This gave a rapid circulation of dry air at a temperature not higher than 120°. Under his careful manipulation this process developed a raisin that was hard to tell from those cured in the sun.

The invention was patented in 1877. Its essential features are a zigzag current passing under each tier of trays uniformly, and devices for the entry of air from hot air chamber, its escape by the flue and control by the blower in such a way as to secure an upward or downward current at will. The majority of raisin-dryers built afterward embodied more or less of his ideas, but he was so much interested in the development of the industry and the country that he never took action to secure the royalty to which he was entitled.

When the dryer was a demonstrated success, he turned his attention to the subject of irrigation. He thought that the sand streaks where his walnut trees failed to grow and the palms and yuccas thrived was once the channel of Cache Creek, the inlet of Clear Lake, and still marked the course of an underground current. A well twelve feet across and twenty feet deep supplied a centrifugal pump to irrigate his eighty acres of trees and vines. To flood alfalfa he still used the waters of the ditch which had for years been at his disposal.

reference so often as the subject of retrenchment comes before the Legislature. Industries seeking appropriations need to give a very clear account of their stewardship.

At school he learned of the laws of pneumatics and so continued his studies and applied the principles as to design one of the most comfortable homes anywhere, to act as a pioneer in the artificial curing of raisins and in the later years of his life to develop a plan for transportation of fresh fruit overland without the bulky and costly method of refrigerating by ice. This was carefully outlined in the *Pacific Rural Press* of December 29, 1898.

Several investigators are following in the wake of his valuable suggestion and we hope to have very soon in successful operation a method of shipping fruit that will land the products of orchards and vineyards in eastern markets in practically the same condition they left home, at little over half the present cost of transportation. Now we carry about as much weight of ice as fruit. Those promoting improvement along these lines have special cause to regret the loss of our friend at the very zenith of his mental activity.

Although a pioneer in many lines of industrial improvement, and so persistent that almost every one of his ideas was brought to the point of success, this story will show that the last year of his life was more fruitful in practical suggestions and was opening up a wider field of improvement than any other.

Miss Austin, Mr. T. C. White and many others who made brilliant reputations in raisin culture, at Fresno, received from him their first cuttings and elaborate

DR. R. B. BLOWERS.

The advantage of the pumping plant rests in command of a water supply at any time needed, and the certainty that no weeds will be distributed by the irrigating water. The fire box in his boiler is calculated to burn straw, peach pits, almond shucks, brush and all the refuse which accumulates so rapidly on a large fruit ranch.

The accompanying engraving shows a part of Dr. Blower's family sitting by the yucca that thrives where the walnut trees died, and the top of the dryer and the big tank in the background. From the smoke we judge that either the blower or the pump was in active motion. Both are run by the same engine.

From 1880 to 1886 Dr. Blowers was a very active member of the viticultural commission. Some difference of opinion proceeding in part from his conception of the duty of a State officer to deal impartially between localities and to expend judiciously all funds of the State, finally caused his withdrawal from the commission.

The controversy, as published in the *Yolo Mail*, of March 27, 1884, the *S. F. Merchant*, of March 7, 1884, and other publications, reflects great credit upon the sincerity of purpose and discrimination of Dr. Blowers and will prove interesting for

practical directions for their management.

At Riverside they had many a trouble with their raisins, and hearing of Dr. Blower's success they wrote so many letters of inquiry that he finally expedited matters by visiting them at their homes and addressing them at their meetings. From this visit they date their era of successful raisin production.

His prominence in the raisin industry was such that many forget that he was a leading shipper of fresh fruits. Almost as soon as the Overland was open for traffic he began shipping grapes and in 1869 sent a car-load to Chicago. Shippers will be amused to hear that the first lot went in an ordinary freight car, each bunch enclosed in a paper sack and packed in twenty-pound boxes. Intending to give all varieties an impartial test several boxes of Sweet-waters were included in this lot. Since then the late-ripening, long-keeping and fine-carrying qualities of the Emperor has made it his chosen shipping grape. Cars of Emperor and Tokay have reached New York in good order after twenty-one days of travel. They had strayed, by mistake, through Kentucky and Tennessee and several other states. Some of the early shipments netted a left-handed profit of \$2,000 per car.

Not many years since it was supposed that all shipping grapes had been ruined by a rain of six inches. He packed 480 crates of Emperors, and ran them into the dryer long enough to get rid of the dampness. They reached so hungry a market in such perfect condition they brought him six dollars and ten cents per crate and more than made up for the loss resulting from the disaster in his early shipments.

Every year elements of risk are being removed and the shipment of fruit approaches nearer to a staple industry. There remains much to be done to secure so direct and economical a contact between producer and consumer as to distribute the possible output of California where it will find a satisfactory demand.

HANDLING AND MARKETING FRUIT.

In 1884 Dr. Blowers was eastern manager of the California Fruit Union and active in establishing the auction system for disposing of fresh fruit on arrival.

The illustration herewith will give a

better idea of the system than paragraphs of description. To win in handling fresh fruit it is necessary to reach the consumer promptly. After a long trip overland it often gets caught by a fresh shipment while waiting in the rooms of the dealers, great and small, to reach the consumer, in the regular course of trade. Many plans have been made to control this business by special advantages designed to create monopolies. Dr. Blower's influence was always in the direction of such a free distribution that each dealer would share in all the advantages it was possible to give in proportion to his trade and facilities and that all shippers should have benefit of information coming to the Fruit Union.

The experience of last season emphasized the necessity of an organization to execute the designs of the Fruit Union and it is to be hoped that those who have had most experience will join with the Fruit Exchange, and with a following in proportion to the present importance of the business proceed to improve upon the plans originally designed by the Fruit Union for the benefit of the industry. The evils of sending three cars where one is needed and leaving other markets for days without any supply are more easily seen than remedied.

The point has been made that only five millions of the people of the U. S. ever have a chance to buy California fruits and that it is desirable to send regular supplies to interior towns that can take less than car lots and have had only small lots at long prices by express.

This opens a field for more persistent effort than railway officials are likely to bestow and needs a worthy successor to our friend to work for the interest of producers. Railroad men could distribute small lots of fruit as easily as they manage the oyster trade if the matter appealed to their pockets as it does to those of producers. So long as the roads have all they can do to carry fruit to main distributing centers there is small hope that they will try plans to cause the demand to keep pace with the supply. With more cars and more roads they will find a way to reach more points.

During '93 Dr. Blowers took a leading interest in a plan to make the natural facilities of Yolo County available for irrigation and power. He wrote many articles for the Woodland papers that

called out opposition from Lakeport editors who supposed their interests were in danger. Some of their leading men discussed the subject with him personally and learned that it was no more harmful to them to have Yolo use the water power from Cache Creek canyon than to breathe the zephyrs that had once fanned their native Switzerland.

AN ABUNDANT WATER SUPPLY.

Clear Lake has an available water supply of 435,360 acre-feet with 1,200 foot fall between its outlet and entry to Cupay Valley at Rumsey. The watershed of the canyon

sation which would release their capital for other investments and enhance value of their remaining property.

Present and prospective prices of wheat offer little inducement to extend that industry and the decreasing fertility of the soil shows effect of steady cropping.

Water brings alfalfa. That dives deep into the subsoil and reaches into the air for its nourishment and restores the humus to the soil. Irrigation will also introduce the varied industries of intensive farming and make small holdings profitable under conditions where no crop is lost and no stock goes hungry.

TWIN CITY FRUIT AUCTION ROOM AT ST. PAUL, MINN.

is more than that of the lake and after a liberal allowance for losses there remains 115,463 horse power. Estimating the value of this at 10 per cent of the cost of wood or coal to generate like power gives an annual rental value of \$731,945 provided all could be utilized.

To accomplish this Dr. Blowers suggested the formation of a Wright-District to irrigate some 300,000 acres and also to develop and distribute the water power. Certain vested rights of present ditch owners are opposed to this but the suggestion contemplated reasonable compen-

In the last ten years, statistics showed that Fresno County, Cal., alone, had gained more in population than the whole Sacramento Valley and it was because of irrigation and intensive farming.

By distributing the water power from Cache Creek canyon by electric transmission over the farms of Yolo it could be made to do a great part of the work now done by horses. In that case it was estimated that one-third the land, the part now necessary for sustaining the animals that do the work would be available for the support of human life. At that rate

70,000 more people would find a living there so soon as such power was used for all the land these waters would irrigate. As soon as the county developed in this way villages would grow into cities; blacksmiths into machinists; retailers into wholesalers; schools into colleges; and colleges into universities.

To preserve this opportunity until the people should be aroused to the importance of action, Dr. Blowers not only thought, spoke and wrote, but although seriously ill he could not be dissuaded from attending the Los Angeles Convention of '93 when he felt that there was danger that Congress would be asked to turn over arid lands and reservoir sites to the States and make it possible for Legislatures to take such action as would place the opportunities of the many under the control of the few.

When action was pending in the Legislature designed to complicate action by declaring the lake the property of Lake County he telegraphed a request to the governor that he withhold his signature until a Woodland delegation would reach him, and this friend of the people rose from his death-bed, long after he had ceased to attend to any private affair, to solicit his fellow citizens personally, to wait upon the governor and use their influence for their county in that crisis.

Not often do we find one, upon whom no official responsibility rests, so zealous for the public good as to place others' interests before his own even to the last day of his life.

He spoke of approaching death as a pleasant journey, and well he might. For one who has lived so much for others knows what the preacher meant when he said: "It is only three steps to Heaven; out of self—unto Christ—into glory."

By precept and practice he was a firm believer in intensive farming, and held that the development of the country rested upon small holdings of irrigated land. He claimed that ten acres of good land, well cultivated, would employ and sustain an average family on a scale of comfort to enable them to live as intelligent, self-sustaining, public-spirited citizens.

His first prune orchard was seven-eighths of an acre. The first five years after it came into bearing he marketed 5,700, 6,700, 7,700, 8,700 and 7,200 respectively, being an average of 7,200 pounds of mer-

chantable prunes for a term of five years. He estimated that ten acres of such land as his would produce 100 tons of alfalfa hay annually or keep twelve cows, ten hogs and 200 hens. If devoted to sugarbeets it would produce 300 tons. On his own home ranch are kept a dozen cows, twenty or thirty dozen chickens, forty to fifty hogs and eight horses.

The balance of the place, not required for stock, is planted with seedless raisins and shipping grapes, olives, prunes and apricots. Many of these are young trees, planted between rows of vines, so soon as he foresaw the effect of free-trade upon the raisin industry.

To colonists he would recommend the care of stock and fruit so distributed as to keep working members of the family always occupied, but never crowded. With irrigated land and small holdings they would be close enough together to have common drying grounds, fruit-shipping stations, creameries, canneries, etc. Each family could have milk and eggs to send to the creamery every day, could have flowers and vegetables to use and spare, and when fruit harvest came could have pears, peaches, prunes, apricots or grapes, figs, almonds, olives, oranges or lemons to sell. With products to market that bring cash every day they would be in a position to buy for cash and avoid the system of credits that has proven the ruin of many new settlers.

For several months Dr. and Mrs. Blowers represented the State Board of Trade upon "California on Wheels," and met many in the east whom they had entertained during excursions of representative bodies to California. All were greatly interested in the exhibit.

The present world-wide depression has so affected prices that the low margin of profit generally connected with safe business, affording constant employment, has temporarily been upon the wrong side of the ledger. Some reason that existing conditions are likely to become permanent and that the farmer of the future will become a peon. Conditions have never remained the same for any term of years in our history, and it is only by averaging results of decades that we can reach safe data from which to estimate prosperity of a vocation.

Accounts show that for the twenty-six years Dr. Blowers farmed his eighty-acre

home ranch he paid out for labor upon it \$80,000. This was almost forty dollars a year upon each acre.

The subject of our sketch never speculated, nor did he take advantage of the many opportunities for profit that came to him on account of his reputation. He was welcomed to all assemblies of representative Californians as among the most intelligent and public-spirited of their number. He trained his children to appreciate and practice the education and refinement of the best city homes and to be thoroughly practical in all the details of his many-sided business.

On one occasion that came to the writer's notice Dr. Blowers was asked to join a syndicate to subdivide a tract designed for a colony of raisin growers. The endorsement of his personal recommendation and his supervision were to constitute his share of the investment, which was likely to net him more than the accumulations of his lifetime. He examined conditions of soil and climate and concluded that, while a good showing might be made for a time, the colonists could not successfully com-

pete with more favored localities in the close race of the survival of the fittest that he foresaw. For this reason he withheld the use of his name.

He has been regarded as a boomer among Californians, and boomers have been looked upon as devoid of conscience. Here was a fortune refused rather than mislead investors.

The genial influence of his personality so pervaded his household that people who have enjoyed its hospitality for years never dreamed that his present wife was not the mother of the children, and he saw no need for any other provision in his will than that all should share alike in the magnificent property he left them.

If ever a life proved a theory this one proved that education is not wasted upon a farmer. The fool may make a *living* on a farm, but that living is better termed *existence*, while the man of thought may live so near to nature and in such sympathy with his fellow men that the living may be one continual joy to himself and a benediction to his race.

RECENT DECISIONS UPON THE SUBJECT OF WATER RIGHTS.

BY CLESSON S. KINNEY, OF THE SALT LAKE CITY BAR.

RECENTLY in the Supreme Court of the State of Colorado in the case of *White vs. Farmer's Highline Canal and Reservoir Co.* (43 Pac. Rep. 1028) it was decided that: The taking and use of water for irrigating purposes is a matter of public interest and subject to state control; and that the irrigation act of that state regulating the taking and distribution of water from streams, and providing among other things that each company controlling canals or ditches shall appoint a superintendent who shall measure to each person entitled thereto, his or her pro rata share of water, applies to and governs companies carrying water for hire and also their patrons, and one consumer cannot ignore the allotment made by the superintendent and appropriate to himself more water than his just share.

It was also held in the same case that the law regulating water rights being in the exercise of the police powers of the state is paramount to a private contract though such contract antedates the passage of the law and rights given by the contract must yield where they are in contravention of the provisions of the statute.

LICENSE TO CONSTRUCT DITCH.

In the case decided Feb. 17, 1896, of *Tynon vs. Despain et al.* by the Supreme Court of Colorado (43 Pac. Rep. 1039) it was held that a parole license to construct and maintain an irrigation ditch over the lands of the licensor when executed by the construction of the ditch is not revocable; and that in an action to recover for damage to an irrigation ditch by its being broken and the water diverted

by the owner of the land over which it passed, the defendant cannot, under a general denial of plaintiff's rights to maintain the ditch, introduce evidence of its enlargement or of its want of uniformity of grade.

RIGHT OF WAY FOR DITCHES OVER GOVERNMENT LANDS.

In the same case as last above cited it was also held: That the revised statute of the United States, § 2339, enacted in 1866 providing that whenever by priority and possession water rights have vested and accrued under local customs, laws and decisions of the courts, such rights shall be maintained and protected and right of way for canals and ditches for such purposes is acknowledged and confirmed, together with the amendment of 1870, § 2340, providing that all patents granted or pre-emptions of homesteads allowed, shall be subject to any water rights or rights to ditches acquired under, or recognized by § 2339, operate as a grant of the right of way for the construction of irrigating canals or ditches over any lands owned by the United States and unoccupied in 1866 whenever the right to build such ditch should accrue under the local customs, laws or decisions of courts, and that such right continued so long as title remained in the Government, subject only to payment of damages to the possessory right of the occupying claimant, stipulated for

in a proviso of § 2339 which reads as follows:

"That whenever, after the passage of this Act, any person or persons shall, in the construction of any ditch or canal, injure or damage the possession of any settler on the public domain, the party committing such injury or damage shall be liable to the party injured for such injury or damage."

It was also held in the same case that the sections of the United States statute above referred to, are a recognition of the legality of water rights given by local customs and laws, and lands granted to the Pacific railroads continued subject to the rights and easements given to such customs and laws, including the right of way for irrigating ditches; such rights being embraced within the reservation of "and other lawful claims" contained in the Act of July 2, 1864, subject to which said grants were made.

CONVEYANCE OF LAND BY PATENTEE SUBJECT TO THE ABOVE EASEMENT.

And also in the same case it was held where an irrigating ditch is constructed over lands while the title thereto is in the United States and the occupant whose possession afterward ripens into a patent, conveys the lands, the grantee takes them subject to the easement of the ditch although no reservation is made in his deed.

CHEAPER POWER FOR SAN FRANCISCO.

BY W. C. FITZSIMMONS.

ONE of the greatest needs in San Francisco is cheaper power. With abundance of cheap power at command, numerous industries not now thought of would without doubt spring up on all hands. A wise merchant invites trade by displaying goods in his show windows. It is thus that millions of dollars worth of goods are sold at large profits which would never have been sold at all unless thus shown to be in stock. So it will be in the manufacturing line. When power, cheap and abundant, is "on tap" and may be had by touching the button, the demand for it will increase incredibly. But first-class coal is, and prob-

ably will continue to be dear in San Francisco and in fact throughout California. Our oil fields though extensive, are not known to be capable of furnishing a permanent supply of fuel for steam purposes. Wood for fuel on the large scale required for extensive manufacturing enterprises is out of the question; it therefore becomes imperative that other agencies for producing power be utilized. Fortunately none of the large cities of the country, except Buffalo perhaps, is more advantageously situated than San Francisco for profiting by electrical power derived from water falls. The recent triumph scored by Sac-

ramento in bringing over the wires thousands of horsepower of electrical force derived from a waterfall in the American river twenty-two miles away, has been an object lesson worth millions of dollars to San Francisco if that city shall have the enterprise and foresight to fully utilize the lesson thus to be learned. While it may or may not be a commercial proposition to bring the Sacramento electrical power to San Francisco, by reason of the distance, yet it is practically certain that an immense power may be derived from a great waterfall nearer to the city. In Lake County, about ninety miles north of San Francisco, lies a large body of fresh clear water, twenty-six miles in length by eight miles in breadth and 140 feet in extreme depth. It is 1,350 feet above the level of the sea. The lake is fed by perennial springs and mountain streams, and has an outlet known as Cache Creek which in the first few miles from the lake falls more than 400 feet, and finally flows into the Sacramento river in Yolo County. Competent engineers allege that electrical power may be transmitted ninety miles with a total loss of only twenty-five per cent of the dynamic force of the waterfall.

Thus we have at our very doors, so to speak, a power capable of transforming San Francisco into a great manufacturing center not surpassed by any other city of its size in America. And all this, too, without in any way detracting from its beauties as a most desirable place of residence, for of course the soot and smoke of countless chimneys would be conspicuously absent. In short, we have everything that reasonable man could ask to make San Francisco and the towns and cities surrounding, hives of industry and thrift. Besides all these natural advantages we have more than a hundred million dollars in the savings banks of San Francisco alone, to say nothing of the millions of unemployed capital lying on deposit in other banks.

What then, remains to San Francisco and the bay cities to enable them at once to enter into their rich and natural inheritance? Simply enterprise, and sufficient civic pride to make full use of the prodigal gifts which nature has ungrudgingly bestowed. All preliminary work has been done and the Clear Lake Electric Power Company has been organized to do the things above outlined. But the company should be backed by ample home capital, and a spirit of enterprise must be shown, else it will be necessary to enlist outside aid in this grand work of development for the benefit of California. But it must be done. The hour has come when to defeat or long postpone so great a work would be unspeakable folly, not to be thought of for a moment by those having the good of the bay region at heart. The response of our local capitalists to the call for aid in developing and utilizing the Clear Lake Electrical plant will go far to determine the measure of their enterprise and civic pride and it is hoped that when fairly presented to them, the money will not long be lacking for the installation of a gigantic power which will make the name of California a synonym for progress throughout the world. In this connection the following extract from the report of Col. O. E. Moore to the Manufacturers' and Producers' Association of this city relating to this subject will be found of great interest:

"The magnitude of this project and its value to San Francisco can hardly be estimated. Power in almost unlimited quantity can be transmitted to the city at one-third the cost of steam power at the present price of coal and the saving to manufacturers in one year will about equal the cost of the plant.

This is in my judgment the first time a practical and economical plan has been presented to solve the problem of cheaper power and I cordially and earnestly recommend it to the Manufacturers' and Producers' Association for their co-operation and support. It is one of the most inviting fields for a very profitable investment of capital that I have ever seen."

THE DIVERSIFIED FARM

In diversified farming by irrigation lies the salvation of agriculture

WHAT TO GROW ON THE IRRIGATED FARM.

BY F. C. BARKER, OF NEW MEXICO.

WHAT is the best thing to grow? is a question often asked, but very seldom satisfactorily answered. The usual advice is to grow what there is most money in. Sometimes there is a rage for peaches, at other times for alfalfa, with the usual result, that whatever crop is popularly believed to be the most profitable, is usually overdone and the markets glutted with an over-supply.

If a man is a working farmer, and understands his business, I believe there is always most money in raising what is consumed in the family, and herein lies the first advantage of having a farm under irrigation. It will always insure food for the farmer's family however small the farm be.

The first consideration, therefore, should be to see that the family is supplied with flour, fruit and vegetables. Wheat may not be profitable as a market crop, if grown on a small scale, but better raise it yourself than pay some one else to do it for you. Besides you probably save freight or hauling and the profits of two or three merchants. The same may be said of corn, which has the advantage of being raised the same year after wheat in many irrigated countries of the South. The fodder will also make very useful feed for stock if a corresponding proportion of alfalfa is fed with it.

Alfalfa is a crop that should never be omitted on an irrigated farm. It will supply more food for hogs, cows, horses and poultry to the acre than anything I know of, and is a sure cropper with plenty of water.

With the crops already mentioned a farmer should insure a regular supply of eggs, milk, butter, poultry and bacon, and have something left over to sell.

But I am aware that this advice, although perfectly sound, will not satisfy the average farmer, who is always hankering after something that there is money in.

Well, on this point I think it good policy to grow that which cannot be successfully grown without irrigation. In my experience those are the crops which usually pay the best in the long run. This is what makes alfalfa such a paying crop. On no other food can bacon and milk be so cheaply raised, and if it were not for the fact that it cannot be grown without irrigation, no farm in the world would be without its alfalfa field.

Celery and strawberries are two other cheap crops which, except in a few favored localities, do much better with irrigation than without. Several strawberry growers in the East have made up their minds that, even where the rainfall is excessive, artificial irrigation is necessary to insure regular crops and they are putting up windmills and other devices for pumping water. I believe the day is not distant, when very few strawberry growers will risk the loss of their crops by droughts, and they must necessarily go to a great expense if they have to pump the water. This expense is saved on the farm furnished with water from a canal. A good principle to follow in business is always to stick to some line in which you have special advantages. Don't do what every fool can do. Do not be led away with the idea that there is a fortune in lemons, or in almonds, or in olives. The natural law of supply and demand tends to reduce the profits on all crops to a level, and what to-day looks the most profitable, will to-morrow be the most unprofitable. But grow what you are best situated and fitted for and you will hardly ever make a mistake.

ONE HUNDRED AND FOUR BUSHELS OF CORN PER ACRE.

[F. D. Coburn, Secretary of Kansas Department of Agriculture, furnishes the following timely article.]

MR. J. A. BAXTER, of Waveland, Shawnee County, Kansas, who raised as high as 104 bushels of shelled corn per acre in 1895, furnishes the State Board of Agriculture the following account of it,

together with some of his corn-raising methods in general:

"The portion of my crop giving a yield of 104 bushels of husked, well-dried (fifty-six pounds, shelled) corn per acre was five acres of fifty-seven I planted last year. My land is slightly rolling prairie and about a fair average of Kansas soil, with a hard, impervious subsoil. The five acres mentioned were at one end of a twenty-five-acre field, part of which had been in potatoes for two years and the last crop dug with a listing plow late in October, which was equivalent to a deep fall plowing.

"In spring the ground was much like a bed of ashes. It was then deeply plowed, made fine and smooth with a plank-drag and drilled the first week in May with a 'Farmer's Friend' planter of medium width, with a deep-grained yellow Dent corn; about the same quantity of seed was used as would have been if from three to somewhat less than four grains had been placed in hills the ordinary distance apart. This was cultivated four times with common gang cultivators and hoed three times—the last hoeing after it had been finished with the cultivators.

"I am a strong believer in deep and thorough cultivation, and long since learned that a good crop of corn and a rank growth of cockle-burs, crab-grass and similar weeds cannot occupy the same ground at the same time. I have not subsoiled for previous crops, but last fall invested in a Perine subsoiler and used it on fifteen acres. I intend planting 100 acres in corn this season and aim to have it all subsoiled. Am subsoiling my fields the narrow way first (they are from forty to eighty rods wide and 120 rods long) as deeply as four horses can do the work, at distances of two and one-half feet. Will then throw up the ridges cross-wise of this with a listing plow, following it in each furrow with the subsoiler as deep as three horses can pull it, and drill the seed immediately in the track of the subsoiler. This will leave the land subsoiled in both directions.

"My whole crop for 1895 averaged only fifty-seven bushels per acre, yet would have made seventy-five bushels but for an unfortunate invasion just at the critical time by an army of chinch bugs from an adjacent thirty-acre field of oats. With proper treatment of our soils and

thorough cultivation I am of the opinion that in all favorable seasons such as last we should raise from seventy-five to 100 bushels of corn per acre instead of the more common twenty-five to fifty bushels. I am always careful to avoid cultivating when the land is very wet, and think many farmers make a serious mistake by working their corn when the soil cleaves from the shovels in chunks. The sun is likely to then bake the ground and the growth loses its bright, healthy green and turns a sickly yellow."

SUGAR TO REPLACE WHEAT AND COTTON.

BY W. C. FITZSIMMONS.

FROM the Florida Farmer and Fruit Grower we take the following:

"We pay annually about \$125,000,000 for foreign sugar. It should all be made here. The sugar-beet crop should take the place of wheat on the great prairies where farmers are in poverty because wheat no longer yields a paying crop, and the cotton fields and the reclaimed glades of the South should be turned into cane fields where they will produce from \$50 to \$100 per acre without bounty."

The above is in some respects a misleading statement; especially that part of it relating to the feasibility of planting the wheat fields of the North and the cotton fields of the South with sugar-beets or cane in the hope of realizing \$50 to \$100 per acre for the crop. It is impossible. Such results have scarcely yet been assured by the best land in the world, when planted on so large a scale, and cannot be on the worn wheat and cotton lands of the North and South.

The total importations of sugar are enormous to be sure; and for the year ending June 30, 1894, amounted to 4,261,360 004 pounds, valued at \$124,720,681. For the previous fiscal year the imports were 3,731,219,367 pounds, valued at \$114,959,870. While it is certain that this immense quantity of sugar can be and should be produced in the United States, it should be also remembered that all land is not adapted to sugar beets or to cane. More than 20,000,000 acres are annually planted with cotton in the United States and the yield averages less than 200 pounds of lint per acre, worth last year about \$10.90. The 34,000,000 acres of land planted with wheat last year yielded but about thirteen bushels per

acre, worth less than \$6.50 per acre at the farm. It is manifestly impossible for land either North or South which yields only thirteen bushels of wheat or 200 pounds of cotton per acre to produce beets to the value of \$100 per acre. And experience in California, Nebraska, Utah and Virginia shows conclusively that the best beet land in cultivation in most of those States does not give the returns announced by the Florida Farmer. But an average of thirteen tons of beets per acre which sold at \$5 per ton during the life of the bounty law is the highest product ever reached in this country and probably in the world on large areas. Thus, while sugar production should be encouraged by all legitimate means, it should not be stimulated by holding out inducements impossible to realize. But let the sugar industries be built up! There is ample room for them to flourish.

PRACTICAL FRUIT AND VEGETABLE IRRIGATION.

JOHN TANNAHILL, of Columbus, Neb., in a recent speech before the Horticultural Society, gave the following as the result of his work:

"From an orchard of apple trees, of which 190 are beginning to bear, I got twenty bushels of apples in 1894, and this year I got from the same trees over 300 bushels. The trees are twenty feet apart; water is run between the rows, and I find that it does not take nearly so much water this winter as it did last, for the reason that the subsoil has been moist since last winter. As an experiment, I left some apple, cherry and apricot trees unwatered last winter; those apple trees not watered were in bloom just six days before those that were watered, with the exception of one tree that I mulched, which, after watering, was six days later and was loaded with fruit. The spring frosts hurt some of those that were watered, but, as they were not overloaded, the fruit was much larger and very superior to that of the others. Of those trees not watered two died and seven had some fruit to set, but it kept dropping until time of ripening, when there was but very little of it left, and that was poor, almost worthless. My

cherry trees, ninety-three of which I watered, bloomed two days later than those not watered, and all were heavily laden with large, juicy fruit, none dropping off or drying up; of the eighteen unwatered, ten died, eight bore very inferior fruit, hardly worth picking, and the trees made but six inches of growth of wood, while those watered made a growth of twelve inches. The cherry trees were watered during the last week of December, and received no water before or after; the apple trees were watered previous to this and when the ground was frozen. Water goes much farther and does more good in orchards if used in winter, but in no case let the water come into contact with the body of the tree, as freezing will injure it. Always have the ground a few inches higher around the tree.

AS TO VEGETABLES.

"I irrigated six acres for vegetables and made more profit off those six acres than off thirty acres unwatered. I grew from one-fourth acre that was watered three crops of cabbage, and the best part of it was that I got a good head of cabbage from every plant. At the same time I had two acres of unwatered cabbage, and I did not get one-fourth as many as from the one-fourth acre, and they were very poor. I plant cabbage two by four feet and water between the rows. The ground should be kept not only moist, but quite wet for them. When I see a cabbage beginning to head, I set a plant close by it, and when it is ready to cut, pull the roots and give room to the plant set a week or ten days beforehand. On all other vegetables on which water was used we were well repaid, as they were larger, smoother and of better quality, and the crop always sure. I have been in Nebraska twenty-seven years and am satisfied that a practical man with five acres under private irrigation would make more money than from fifteen acres without irrigation; and no one need to be without it in our valleys, as we have plenty of water just a few feet below us, also plenty of wind above us, and by combining the two I believe we can irrigate more land than we can from rivers and creeks by ditches, believing that there is more water passing in the underflow than passes down rivers and creeks."

CAPACITIES OF WINDMILLS AND PUMPS.

Sizes of irrigation mills and pumps best adapted for each other to work successfully under ordinary conditions.

10 FOOT MILLS.					n't of Water in 24 hours.	Amount of Land Covered.	Size of Reservoir.
Size of Mill.	Diameter of Pump Cylinder	Depth of Well.	Length of Mill Stroke.	Am't of Water each Stroke.			
10 feet.	8 inches.	30 ft. and under.	10 inches.	1 1/2 Gals.	57,600 Gals.	103 acres.	90x75 ft. interior dimen.
10 "	6 "	50 "	10 "	1 1/4 "	61,200 "	86 "	90x60 "
10 "	4 "	75 "	10 "	1 1/8 "	81,600 "	37 "	90x40 "
						13 "	50x30 "
12 FOOT MILLS.					n't of Water in 24 hours.	Amount of Land Covered.	Size of Reservoir.
Size of Mill.	Diameter of Pump Cylinder	Depth of Well.	Length of Mill Stroke.	Am't of Water each Stroke.			
12 feet.	10 inches.	30 ft. and under.	12 inches.	4 1/2 Gals.	180,000 Gals.	103 acres.	90x75 ft. interior dimen.
12 "	8 "	50 "	12 "	3 1/2 "	151,200 "	86 "	90x60 "
12 "	6 "	75 "	12 "	2 7/8 "	94,800 "	37 "	90x40 "
12 "	4 "	125 "	12 "	1 3/4 "	31,680 "	13 "	50x30 "
14 FOOT MILLS.					n't of Water in 24 hours.	Amount of Land Covered.	Size of Reservoir.
Size of Mill.	Diameter of Pump Cylinder	Depth of Well.	Length of Mill Stroke.	Am't of Water each Stroke.			
14 feet.	12 inches.	30 ft. and under.	14 inches.	6 1/2 Gals.	251,800 Gals.	146 acres.	125x80 ft. interior dimen.
14 "	10 "	50 "	14 "	4 1/2 "	174,240 "	100 "	90x75 "
14 "	8 "	75 "	14 "	3 3/4 "	100,800 "	63 "	75x60 "
14 "	6 "	125 "	14 "	2 3/4 "	71,560 "	40 "	65x40 "
14 "	4 "	175 "	14 "	1 1/2 "	40,820 "	23 "	50x30 "

* Amount of land that can be covered 1 foot deep with windmills working at the rate of 15 hours per day for 300 days in the year. Acres covered 1 foot deep e 4 ft. depth of water, height of bank 6 ft., width of base 16 ft., 2 ft. of water r by overflow pipe in order to utilize full capacity of mills and pumps. ank 45 ft., acre size 20x ft. on each side, corners rounded; 2-acre size 200x418 ft

An Object Lesson.—Two days after irrigating my acre patch of strawberries the other day I started my Mexican boy in with a wheel hoe to cultivate the soil. After doing about half an acre, which took him some six hours, he remarked to me in his native tongue, "Patron, it seems to me that this stirring of the soil will make it dry out much faster than if left alone." "I don't think so, José," I replied; "you hoe your chili after each irrigation. Why do you do it?" "Because it won't grow thriftily unless we keep the soil around continually hoed," he explained. "Yes," I replied, "it is because the loosening of the top soil preserves the moisture and lets in the air to the roots." To-day, nine days after the last irrigation, I took my Mexican to a patch of ground that had been left unhoed, and he was obliged to admit that at a depth of three inches it was much drier than the land he had hoed. To-morrow we irrigate the strawberries again, and when the Mexican hoes them, he will have the satisfaction of feeling that at any rate it is not labor lost.—F. C. Barker.

Antidotes for Alkali. There are antidotes for all the different forms of alkali. The neutral alkali salts, common salt, Glauber's salt, sulphate of potassium, etc., are only injurious when present in large quantities, and must be washed or drained from the soil. There are but few localities where there are such quantities as here. The soluble earthy and metallic sulphates and chlorides, such as Epsom salts, bittern, chloride of calcium, alum, copperas, etc., find their antidote in lime, says a writer from New Mexico. Alkaline carbonates and borates, which are the most injurious, rendering the soil-water caustic and corrosive, find their antidotes in gypsum or land plaster.

The experience on my own land, where I am cultivating purposely the greatest variety of plants, shows that there will be practically little trouble in overcoming all difficulty from alkali. In fact there is scarcely a thing we have planted where it has been properly irrigated, which has not made satisfactory growth. If we find an exception it is almost invariably because water has been permitted to stand around the plant for lack of proper drainage, or in places where too much water has settled during irrigation, and this has been quickly remedied by providing the drainage.

Estimates made on data taken from the U. S. Signal Station at North Platte, Neb. Least working power of wind estimated at 15 miles per hour.

Asparagus in the Garden.—A writer in the Montana Fruit Grower says that in his village there are four hundred gardens but only twenty asparagus beds. Writing of the little care necessary to have this delicious vegetable in ample supply for the family, he says: "Seventeen years ago I set an asparagus bed, ten by fifteen feet, using fifty plants in rows three feet apart. The ground was prepared the same as for an onion bed. For fifteen years that bed has been cut every other day, from its first appearance late in April until July 1. As soon as the last cutting is made, about four inches of fine, well-rotted manure is put on. No further care is needed, except to take out the weeds coming up from the manure. The tops may be cut and burned in the fall, or left until spring to retain the snow and prevent deep freezing. As soon as the ground can be worked in the spring, the manure should be forked in, being careful not to injure the crowns, which can be felt the moment the fork touches one."

An Important By-Product.—An Eastern fruit dealer saw a specimen of dried orange peel on exhibition at Los Angeles and had this to say about it: "That is the first lot of California dried orange peel I ever saw which comes up to the requirements of the trade, and that is as good as the very best I ever saw from Italy. The peel is cut properly from point to stem, so that they are about an inch wide at the middle. The white is all carefully removed from the outer peel, and the goods are nicely dried. They are of a high, rich color, and perfect in all respects. In New York that peel is worth eighteen cents a pound, wholesale price. A great deal of it is used in making elixirs, cordials, biters, etc. The refuse oranges of Southern California ought to be put through a proper press to express the juice, which will sell in large quantities in Eastern cities. Phosphates are all the go now, and orange phosphate is one of the most popular."

Growing Celery.—The time for transplanting celery is now at hand. Probably the best variety for general crop is the Golden Dwarf, although the White Plume and many other kinds are recommended as their equals. If the plants have not been grown in a cold frame or out of

doors, they can be purchased from those dealing in vegetable plants. The ground for celery should be well prepared to obtain the best results. A soil that is rather damp, but not wet; a heavy loam containing but little sand, or a spot slightly approaching to alkali, will make a good place for celery, providing the land is rich enough.

Early varieties may be transplanted any time during June, while the late kinds will do well if not planted till the middle of July in most sections of the irrigated region. The plants should be removed from the bed with care, to prevent breaking the roots. To secure uniformity in growth and make cultivation easier, the plants should be of a similar size and set about fifteen inches apart when transplanted. They should be planted in rows and irrigated during the planting by allowing a small stream to flow down the row where the plants are set. The treatment for two months consists in good cultivation and frequent irrigation.

Simple but Important.—The first three commandments in successful fruit growing are:

Thou shalt not use poor plants.

Thou shalt not set plants carelessly.

Thou shalt not use ground until well fertilized and thoroughly prepared.

Neglect these three things and all the woes of a careless grower shall be thine.

A Demand for Horses—There is getting to be a strong demand in England, and in other parts of Europe, for American horses. It is said that one dealer has taken contracts for the supply of 6,000 head for the omnibus and cab trade of London. These horses will be gathered in Missouri, Illinois, and Kentucky. Heavy draft-horses are also in demand, and the supply is becoming very short. These are pointers which farmers and stock raisers should not disregard.

A New Treatment for Eggs.—Dried eggs are being put upon the market. Fresh eggs are broken and churned by machinery, and the mixture is then evaporated to dryness. They are claimed to keep indefinitely in this form. When cooked with hot water, in various ways,

they are said to taste precisely like fresh eggs. It promises to become an important industry and evidently will not require an expensive plant.

Remove the Dead Shoots.—Professor Hyane, of the State University of California, and Professor George Husmann, of Napa, both advise that when vines have been frosted the frosted shoots should be either cut or broken off promptly. The reserve buds will then push out and often make a fair crop. If the frozen shoots are left, the frozen sap sours the wood and injures the vine.

A Killing Committee.—In an admirable paper read before the Knox County (Ill.) farmer's institute by James H. Coolidge, Jr., and full of practical suggestions, he says:

"It has been suggested that there ought to be in every community a killing committee, whose duty it would be to make an annual round and order all unprofitable cows killed. That would include all cows which do not produce 200 pounds of butter in a year or its equivalent in milk. I think I can conscientiously commend that suggestion."

The Difference.—Miss Clover and Mr. Cowpea will drag nitrogen out of the air and give it to you. The fertilizer dealer bags it and makes you pay 16 cents a pound for it. The difference in price between dragged and bagged nitrogen may represent the difference between profit and loss, says The Rural New Yorker.

Length of Corn Roots.—Professor King, of the Wisconsin experiment station, estimates that all the roots of a healthy corn plant, if laid end to end, would equal one mile in length. The root development measures the leaf development. I have usually found small ears on stalks with small root development, and large ears on stalks with large root development.

Keep your chickens out of the water-trough where they drink.

Thorough preparation of the seed bed saves time and cost in the after attention.

Where you find better stock you are

sure to find better breeding or better feeding.

Salt is an essential constituent of the blood. Cattle should be supplied all they will use.

An acre of good alfalfa will furnish pasturage for ten or twenty hogs per season.

Prairie or sward land ought to be thoroughly subdued before trees are planted in them.

Never use fresh manure on onion ground just previous to planting. It will give you a weed crop too quickly.

Wide tires on your wagons will make lighter draft for your teams and will improve rather than injure the roads.

The little scratching hen adds to the wealth of the country every year in eggs as much as the output of both iron and wool—\$185,000,000.

The fruit raiser who provides for the production of his own home supplies of all kinds of farm and garden produce will be the more independent.

Alfalfa should not be planted in an orchard. The roots go deeper than those of fruit trees, and the growth will be retarded if the trees are not killed.

Getting the corn ground ready is one of the big jobs in the corn states each year, and it has to be well done every time if good results are to be expected.

If sheep are dipped a few weeks after shearing, it will more than compensate the cost by an improvement in the weight and quality of the wool, and in the better health and comfort of the animals.

Cut alfalfa just after it has completed the full bloom and before it has begun to turn yellow near the ground. Irrigate just before cutting and harrow immediately after if you wish to get quick recovery and perhaps cut an extra crop in the season.

According to the American Cultivator forty million eggs are used by the calico print works each year, photographic establishments use millions of dozens, and wine clarifiers call for over ten million dozens. The demand from these sources increases faster than the table demand. They are used by book binders, kid glove manufacturers, and for finishing fine leather.

MAXIMS FOR THE IRRIGATED FARM

If you starve your land it will starve you.

Frequent cultivation helps out irrigation.

The rougher the surface the longer the road.

Poor roads cost most and are worthless always.

Stunt a calf and it becomes a poor investment.

Adversity may bring blessings, though disguised.

A manly man meets and overcomes difficulties.

It is the attractive goods that command best prices.

Fruit is one of the best medicines, and the cheapest.

Do your best and you need not fear consequences.

There is a right way and a wrong way to do everything.

Many start all right but do not hold out as they begin.

A single weed may furnish seed to stock a farm. Don't let it.

Fruit growing is not a business to be undertaken by mossbacks.

Turn the soil early in the fall and plant it early in the spring.

If you send inferior stuff to market you cannot hope for high prices.

You can't live long enough to learn all there is to know about farming.

If you cannot know but one thing it is better to know that thoroughly.

It is one thing to know what ought to be done, and quite another to do it.

The best machine for the conversion of corn into money, is a well-bred hog.

Think—Can you tell why there are so many gray horses and no gray colts?

Buy shoes at the close of the day when your feet are at their maximum size.

It is not good sense to breed a class of animals for which there is no demand.

Flowers, in doors and out, are the most attractive of all forms of ornamentation.

Those who loaf at the store and whittle are not the fellows who raise good crops.

The little things that farmers cannot find time to do are sometimes most important.

The alfalfa farmer of the west makes many blades of grass grow where one grew before.

Diversified crops, careful attention, patience and perseverance contribute to success in farming.

Save it all and make the most of the farm manure; it is an important resource; to waste it is criminal.

It is the food it eats that keeps the animal warm. If fed in the open air it takes so much the more fuel.

A farmer cannot know too much about his farm, and he ought also to know something about the markets.

It takes a very conscientious man to hold to the straight and narrow path when the pocket nerve is involved.

It is not a prudent farmer who wastes the feed in winter which it has cost so much labor in summer to produce.

Rotation of crops is one of the best preventives against the spread of the various pests and worms that feed on different farm products.

It is a patent fact that reading farmers are as a rule the prosperous ones. Reading stimulates thought, and the more a farmer thinks, the bigger his crops will be.

Your grandfather might have been a good man and your father before you, but times now and then are different. It is the present to which you must adapt yourself.

Andrew Carnegie, speaking to the Cornell students advised them that the wise man would put all his eggs in one basket and then watch the basket; in other words adopt a specialty and get to understand the one thing perfectly.

THE PROGRESS OF INVENTION

A NEW machine for making cans turns out 120 a minute, or 72,000 every ten hours, with one man and five boys to attend it. The cost is but a trifle in addition to the first cost of the tin.

ELECTRIC locomotives have shown themselves to be fifty-five per cent cheaper in coal consumption than steam locomotives.

TESLA claims that his phosphorescent light is so closely a duplicate of sunlight that it can scarcely be distinguished from it. It possesses all the health-giving qualities and drives away dampness. The light is already an accomplished fact.

A NEW JERSEY man raising vegetables for the New York market has spent \$25,000 in electric culture and facilities, and it is said he has increased his production from 40 to 60 per cent.

THE latest design for a fire extinguisher is a quadricycle, or two tandems coupled together. They carry the extinguishing liquid and a supply of hose between the two and are operated, including the run to the fire by four men. It can beat a horse outfit getting there.

SANTA BARBARA, California, is trying a new form of street paving for which it has all the materials at hand. They have an asphalt mixer that uses wet sand. A crusher, on the other side of an oil-burning engine, crushes the rock from the beach. A compound of crude and refined asphaltum is spread one and a half inches thick, and while it is hot a coating of crushed rock and sand is spread over and rolled in, making a total thickness of two and a half inches.

BOTH Edison and Tesla have been closely engaged in studying the Roentgen X-ray discoveries with the result of adding many important discoveries to the original. By the "fluorescent screen" Edison succeeded in getting astonishing results without increasing the electric intensity, saving time in exposure and producing results which might be seen by the naked eye. His inventions are along the practical line, and it is announced that his discoveries will not be patented, but are given for the free use

of the public. Tesla has worked in the direction of increasing the electric intensity. Where others have used voltage re-coined in thousands or hundreds of thousands, he has used millions. His object was to secure vast power in the vacuum tubes and he has succeeded. A news telegram tells of his accomplishments in these astonishing statements:

"The skeleton of one of his assistants, who stood at a distance of five or six feet from the tube, which was giving off rays, was seen plainly. But that was not all. Tesla has finally perfected the X-ray tube to such an extent that he saw completely through skeleton as well as flesh. One of his assistants held a brass plate in front of his chest, moving it up and down. The X-ray had penetrated the body, and through the fluorescent screen Tesla could distinctly see the brass plate as it moved.

A NEW machine which bids fair to revolutionize the cigar-making industry is reported from Binghamton, N. Y. Machines are said to be on exhibition in operation there now, which are turning out smoothly bunched and neatly wrapped cigars at the rate of three thousand per day for each machine. This is about three times as many as an expert can roll when using moulds. The machine is of about the size and appearance of a sewing machine and is as easily operated. The essential mechanism consists of a metal plate, a traveling rubber belt and two rubber rollers. The plate has a beveled or warped surface of varying sections, on which cigars of all the approved shapes can be made by a simple adjustment of a clamp. A "bunch" of tobacco is inserted between the rollers and the traveling band. At the same time a wrapper is fed upon the plate and automatically guided around the bunch. The "tucking" and "pasting" are done while the next are being rolled, so that two cigars are in process of manufacture at the same time. It is estimated that with these machines all shapes and qualities of cigars can be made at a labor cost of thirty cents per thousand.—*New Ideas.*

PULSE OF THE IRRIGATION INDUSTRY

IRRIGATION IN CENTRAL KANSAS.

BY A. C. ROMIG.

TO irrigate or not to irrigate; that is the question that has engaged the attention of many farmers in Central Kansas for the last twelve months.

In location we are occupying debatable ground; it is not definitely settled whether we are arid or humid.

From 1892 to 1896 we were decidedly arid; but now that the rains have come we think we are humid; and the hesitating farmer has decided to postpone his irrigation schemes indefinitely. He has a conviction imprisoned in his brain, that in the cycle of years, we have passed the period of drought, and are entered upon the threshold of a series of wet and prosperous seasons; that the dread calamity of hot winds and crop failures are at an end, irrigation unnecessary, superfluous, and an expensive luxury.

The buoyant hopefulness and simple faith of the average Kansan is sublime.

But the true advocate of intensive farming is not so optimistic, and is not so easily swerved from his purpose by doubtful promise of better seasons ahead. Too often in the history of her existence has the great Sunflower State, in emulation of Macbeth's witches, "*pattered with us in a double sense, has kept the word of promise to the ear and broken it to the hope.*" The wary irrigator is not deceived; profiting from his experience of 1895, he is pressing steadily onward to assured success and grander results in 1896.

There is a phase of irrigation, however, upon which we may all agree, *the value and importance* of impounded storm waters stored for future use or for immediate service in flooding the ground for the plow and seeding; in our prodigal waste of this valuable element we imitate the North American Indian, whose chief concern upon receiving his quota of rations at the agency, is to get rid of them in the most expeditious manner.

Instead of constructing ponds and basins for the conservation of this *wealth-yielding fluid*, it is our custom to open up the sluice-ways and speed it onward in its race to the sea where it is not needed.

But our people are learning a better thrift, by study of the Orient, where irrigation has been in successful practice for four thousand years, and where no drop of water is permitted to run to waste.

Central Kansans are becoming interested and much is being accomplished in this direction through individual effort by the construction of ponds and basins on the farm.

All over the plains of Kansas there are low-lying flats or gentle gradients, where an indifferent dam, easily and cheaply constructed for temporary use, may serve the purpose of flooding a considerable area of ground, and hold the water imprisoned until absorbed by the soil and well out of the way of plow and seed.

This system of irrigation was in vogue on the river Nile two thousand years ago, and was practiced in a small way in Central Kansas in the winter of 1894-95, and in every instance the result was not only highly satisfactory and the crops phenomenal, but it was a revelation of possibilities within the reach of every farmer however poor.

There is thrift in the conservation of storm waters.

IRRIGATION ON THE SOUTH PLATTE.

BETWEEN Julesburg, Colo., and Big Springs, Neb., the towns being only a few miles distant either way from the state line, are a number of irrigation pumping plants and also considerable land under ditches.

Starting from Julesburg and going down the valley the first irrigated farm reached is that of F. M. Johnson. Mr. Johnson has paid for his windmills, made a good living and now has about five acres covered with a young orchard and small fruits.

The T. V. ranch owned by Omaha

people consists of several thousand acres of grazing and natural hay land. It is watered by a 14-foot Mogul windmill working a 12-inch pump on a 14-inch stroke. The pump throws $6\frac{1}{2}$ gallons per stroke. It is not intended at present to water all of this ranch, but merely enough to grow fruit, vegetables and alfalfa.

A. J. Walrath, a stock raiser, built a small reservoir two years ago. Has grown plenty of vegetables for home use and now has a young orchard and small fruit such as strawberries, raspberries and blackberries.

G. B. Hoover, two miles west of Big Springs, is an old settler. He located

(windmill) irrigator of Nebraska and it is conceded that he has the largest windmill irrigation plant in the state to-day. It consists of a 14-foot Mogul mill operating a 12-inch pump with 14-inch stroke and throws $6\frac{1}{2}$ gallons per stroke. Sometimes 30 strokes a minute are made. Also a 12-foot Mogul mill working a 10-inch pump with a 12-inch stroke throwing four gallons per stroke. Also a 14-foot steel mill working an 8-inch Mogul pump, 10-inch stroke, and also a 12-foot Leach mill connected to a 6-inch pump. Mr. Stafford has a reservoir covering two acres five feet deep with water, stocked with black fish. Has a fine four-year-old or-

TWO-YEAR-OLD PRUNE ORCHARD, K. S. D. RANCH, NEAR ONTARIO, ORE.

first on the table land, was starved out and then bought forty acres in the valley. About a year ago he put up a 12-foot Mogul mill working a 10-inch pump. Irrigated about ten acres, raised corn, millet, sorghum, onions, potatoes, and vegetables of all kinds.

Abbott and Kimball and Geo. Thompson, of Big Springs, built a small ditch to water 500 acres of hay land. They cut twice as much hay last year as a result of watering.

W. T. Stafford's farm is located on the south side of the river, six miles from Big Springs. Mr. Stafford is the pioneer

chard of apple, cherry and plum trees. Has grown strawberries at the rate of 5,000 quarts per acre, on a half-acre patch, in bearing the past three years. This year has planted an acre each to strawberries and raspberries. Has grown blackberries, raspberries, gooseberries and currants with great success. Has grown 8,000 cabbages per acre averaging five pounds per head, and 400 bushels onions and 200 bushels potatoes per acre. Has also grown large crops of millet and sorghum. At the present time Mr. Stafford has 50 acres irrigated, but thinks he has enough water to cover 70 acres when the ground is leveled. He

began irrigating in the spring of 1891 and has increased his acreage every year since then. He is an enthusiast in regard to the prospects of the South Platte valley. One of his ideas is that the state of Nebraska should offer a prize for the best planned and operated 20-acre irrigated farm.

John Kortz settled on table land but was obliged to abandon it and locate in the valley. He has a few acres irrigated by a windmill and grows plenty of garden truck for home use. This spring Mr. Kortz planted a nice orchard. Part of Mr. Kortz's land lies under the canal described below.

The Miller and Warren ditch starts about seven miles west of Big Springs, is seven miles long and covers about 4,000 acres of land. The ditch is sixteen feet wide at the bottom and two feet of water at the head. It is practically completed and water will be turned in by the time this appears in print.

George Warren, an old settler and one of the owners of the ditch, has a nice farm and will irrigate it from the ditch. The land of R. Beach is also under the ditch. He has a promising crop waiting for the water. Mr. Miller, also a stockholder in the ditch company, has a large body of land under the canal.

Abbott and Kimball have a fine stock ranch on which is a grove of trees grown by means of pump irrigation. They are large stockholders in the new ditch and are the most enterprising business men of Big Springs.

Big Springs is a growing and thrifty town of 200 inhabitants, with a church, school, stores, hotels, livery and other industries.

THE CONGRESS REPORT AGAIN.

I notice in the May number of *THE IRRIGATION AGE* a letter from Fred L. Alles, ex-secretary of the Irrigation Congress, in regard to the reports of the fourth congress held in Albuquerque last September.

It is due the members of the Fourth National Irrigation Congress that an explanation be made as to why this report has not been sent out. The local committee and the territorial committee each had a fund to draw on. The local committee had the funds subscribed by the city of Albuquerque, and the Territorial Commit-

tee had the \$2,500 appropriated by our Legislature. The Territorial committee in the division of work and expenses agreed upon between the two committees, were to publish the reports. I have had many letters asking for these reports, which I have referred to Col. Max Frost, president of the Territorial committee, Santa Fe. Some two months ago Col. Frost wrote me that 500 copies would be ready for distribution in "a few days," since which time I have heard nothing. I think if those wishing these reports will write Col. Frost, he will accommodate them with a copy.

I make this explanation because I feel it due to our own people, who responded so nobly to the Committee's call for money and help to entertain the Fourth National Irrigation Congress, that no false or erroneous ideas get abroad as to why these reports are not out.

I may say that the death of Hon. Walter C. Hadley, secretary and treasurer of the Territorial committee has no doubt delayed an earlier issue of the report.

J. E. SAINT,
Chairman Local Com. Fourth National Irrigation Congress. Albuquerque, N. M.

A GLANCE OVER THE FIELD.

ARIZONA.

Phoenix wants a packing house with ample cold storage.

The Highland canal has had plenty of water this year, and farmers under it are jubilant over their flattering prospects.

The 700-foot tunnel on the Rio Verde canal is completed, so that the twenty miles of canal already finished can be utilized.

The proposed Hudson reservoir will have a capacity of 900,000 acre-feet of water. Some of it is needed now; all of it will be needed in the future.

The strawberry growers around Phoenix have entered into an arrangement by which all fruit is placed in the hands of a single merchant, thereby controlling and regulating the price. The berries are of superior quality; it is claimed they are much finer than California fruit.

A bill has recently passed Congress, and has become a law, under which university and school lands of Arizona may be leased under such rules and regulations as may

hereafter be prescribed by the legislature of the territory. Until the legislature acts the governor, secretary of the territory and territorial superintendent of public instruction shall constitute a board to lease said land. Leases cannot be made for a period to exceed five years.

CALIFORNIA.

Ontario wants a cannery establishment.

Broom-corn raising is to be undertaken at Whittier.

A horse market has been established at Los Angeles.

The California Raisin Association has been incorporated at Fresno.

Since 1894 not less than 1,000,000 olive trees have been set out in the state.

The grain crop in Southern California is not promising very large return this year.

Redlands has shipped 725 carloads of oranges this year, and has obtained very satisfactory prices.

Three hundred carloads of celery have been shipped from one station in Orange county this season.

Five carloads of machinery and appliances were recently received for the new cannery establishment at Fresno.

Since the opening of the new tourist hotel at Redlands some dozen sales of real estate have been made to its guests.

The little city of Hemet is thriving. They are making large sales of land under its canals, and many public improvements.

Redlands entertained twenty-four carloads of hotel men at an orange lunch on the occasion of their recent visit to the coast.

Sale of the Alessandro town site property was ordered off by the superior court. The company was successful in opposing the sale.

The San Francisco and San Joaquin valley road is nearing completion, and the making of a freight tariff is receiving the attention of its officers.

An insect mite has appeared which bores ragged holes in the back of the scale bugs, and it clears the trees in an orchard of the scale pest in a single season.

The fruit exchanges are proving to be the salvation of the orchardists. While they may grow no better crops, they are getting better prices for them.

They are selling water at Hemet at from two to three cents an inch, it is so plenty. The News truly says that water at three cents an inch is just like finding it.

"White Hat" McCarty's fine horses have been removed from Stanislaus county to some choice pasturage near Fresno, where they will have a permanent home.

Another irrigation dam has been blown out in Tulare county as the outcome of antagonisms among the property owners. It is rather an expensive method of venting spite.

The earliest shipment of cherries ever made from the State was sent from Suisun to Chicago, April 3. The previous record was April 27. The shipment was of fine quality and size.

An experiment is being tried in a damp place in the Cajon Pass in cranberry raising. One hundred plants have been obtained for trial. If they succeed it will introduce a new industry on the coast.

Land owners in the Alessandro valley are developing water around the edge of the valley by clearing the cienegas and sinking wells. The exorbitant prices that are being charged for water is compelling them.

A great public market is one of the new things under discussion at San Francisco. Railway and river transportation companies are favoring the plan, and a location on one of the wharves is likely to be selected for it.

The Chino ranch has been sold to an English company for \$1,600,000. Mr. Gird will retain a considerable interest in the property and will still be a factor and moving spirit in its management. This does not include the beet-sugar plant.

The Riverside Press says: "Growers who have sold little lots of grape fruit this winter at phenomenal figures are sorry they had not planted this fruit in larger quantity a few years ago. A carload at \$8 a box would foot up \$2,500 or more.

Dr. R. D. Davidson, county veterinary surgeon, is treating "blackleg" and "anthrax" successfully by inoculation. He sent directly to the Pasteur institute in France for the virus used. The expense is small and the treatment promises to become general.

Covina orchardists and berry men are protesting against a proposition on the

part of the Azusa water company to raise the price of water during the coming season. There is a decided tendency all through Southern California to increase the water rates.

Ontario claims to have produced the biggest, heaviest, juiciest lemon ever grown between the north and south poles of this hemisphere. It weighs twenty-one ounces and its two measurements are $14\frac{1}{2}$ and $13\frac{1}{2}$ inches respectively. Redlands denies, and claims one bigger by four ounces.

Large orders, covering practically the entire season's crops, have been received by the Los Nietos Walnut Growers' Association. The success of the association has been gained by organization and the World's Fair exhibit, which created a demand for the California product.

A. R. Smiley, of Redlands, offers \$200 in five prizes to the persons in that city who shall maintain the neatest and handsomest grounds during the coming year. The object is to encourage the planting of ornamental trees and shrubs, and thus add to the attractiveness of the place.

COLORADO.

Some of the leading potato growers in Weld county have been getting in new potato seed of improved varieties.

There is a twenty-five per cent increase in the grain area of the San Luis valley, and of 100 per cent in alfalfa this year.

An ice gorge in the Rio Grande carried away five bridges, and the Riverside railroad bridge was saved by the use of dynamite.

The acreage of trees planted in the Grand valley is greater than ever before this year, and the stock has been better selected and of better quality.

State Engineer Sumner has issued a letter of instructions and advice to users of irrigation waters, in view of an expected scarcity the present season. The snow-fall has been light in the mountains.

IDAHO.

The Galloway ditch, near Weiser, is being enlarged to add to its capacity for this year.

The Statesman is advocating the organization of a state fair association and, of course, wants it located at Boise.

An active fight is in progress between the American Falls Canal and Power Company and the People's Canal Company for the control of the lands available for irrigation near the American Falls. The state appears to side with the first-named company, and the Interior Department in its rulings favors the state.

Work on the canal of the Lewiston Water and Power Company is progressing rapidly and it is expected that water for irrigation will be turned in early in June. The ditch begins six miles above Asotin in Washington and takes water from Asotin Creek. There is an immense amount of flume construction involving the use of hundreds of thousands of feet of good Oregon fir lumber. This is one of the largest enterprises being carried on in Idaho at the present time. E. H. Libby is president and C. C. Van Arsdol, chief engineer.

KANSAS.

The "Populist" weed hoe is a new invention intended to save a man from back-ache — a great invention.

Alfalfa seed has been so scarce and the price so high, at Garden City, as to interfere with the planting which was intended.

The Wichita Eagle says "Possibly this is a year in Kansas when the calamity howl will have to be postponed on account of rain."

The creamery at Harper is now using 80,000 pounds of milk a day and its payments to the farmers foot up \$1,000 monthly.

Six inches of water fell in less than a quarter of an hour in Dickinson county recently. It is hardly necessary to add that it gave the ground a thorough wetting.

The Garden City section was visited by a thirty-six-hour rain with a precipitation between three and four inches, wetting the ground deeply so that the prospects for a good crop were never better.

A co-operative congress, for the purpose of uniting the various co-operative enterprises of the state into one body for educational, social and business advancement, was held at Topeka, April, 9, 10, and 11, under the auspices of the State Farmers' Alliance. Many interesting papers were read, a state association was organized

electing C. B. Hoffman, Enterprise, chairman; O. B. Wharton, Emporia, secretary-treasurer; Alonzo Wardall, Topeka, chairman of executive committee.

The Kansas Immigration and Information Association, of which W. C. Edwards, secretary of state, is president, announce that their "Kansas Souvenir" is now being printed, and will be ready for distribution soon. This will be one of the most valuable books about Kansas, relating as it does to everything of interest in the state. The articles will be from the pens of the most noted writers, among them:

Ex Senator John J. Ingalls, Governor Morrill, F. D. Coburn, secretary board of agriculture, Geo. T. Fairchild, president agricultural college, E. R. Moses, chairman national irrigation executive committee and many others. Every industry in the state will be fully and carefully treated. Copies can be obtained from W. C. Edwards, the secretary of state, Topeka.

NEBRASKA.

Nebraskans think they are marching to prosperity this year.

There are 9,000 acres planted to sugar beets this year and the industry is a growing one.

Senator W. R. Akers has been elected State engineer in place of R. B. Howell, who has resigned.

More than one thousand applications for ditch privileges have been filed with the state board of irrigation.

Arbor day is not a dead letter in this state. Over a million trees were planted in its daylight hours. Liberal premiums were offered by societies and individuals for the largest planting.

The additional mileage of canals proposed under the new irrigation (Carey) law between April 4th and December 31st of last year, amounted to 2,113 miles, estimated to cost \$6,209,285, and to cover 2,387,689 acres.

The Southeastern Nebraska G. A. R., Reunion will be held at Falls City, Neb., July 20-25, and a number of notable speakers are promised for this occasion. Wm. Reece, the secretary, has issued a general invitation to old soldiers and their friends.

The abundance of subterranean water this year is matter of general remark, and where the earth has been destitute of moisture to considerable depth during the past three years, water is now so near the surface as to appear in post-holes immediately they are bored.

The Nebraska Irrigation Fair at North Platte, October 9, 10, 12, 13, 14, 15, 1896, promises to be one of the most important meetings ever held in the state. The officers and board of managers are all working very hard to make it a great success. Buffalo Bill's Wild West Show will exhibit at North Platte during the Fair.

It is expected that work will begin soon on the Great Eastern Canal which will cover a vast amount of land in Eastern Nebraska. The canal starts in Nance goes through Platte and Colfax counties and extends into Dodge county. H. E. Babcock, of Monroe, is the president of the company and very enthusiastic in regard to the matter.

NEW MEXICO.

One farmer in Mesilla valley is planting 150 acres to tomatoes.

The water company at Santa Fe is preparing its splendid farm lands near the government Indian school for a big acreage of Kaffir corn and sugar beets.

There was a snow-fall of unusual depth covering the Santa Fe section and northern New Mexico, about the middle of April, insuring full streams for irrigation and a prosperous season.

Santa Fe is congratulating itself that a bill has passed the United States senate granting the Fort Marcy reserve to the American Invalid Aid Society to be used for purposes of a national sanitarium for pulmonary sufferers.

The Santa Fe New Mexican is getting out an edition of 50,000 copies of a twenty-page paper which will present the resources of the entire territory in a comprehensive way. Cheap immigration literature is in demand, and the publishers are promised a liberal patronage.

M. W. Mills reports a heavy fruit crop on his large orchards in the Red River valley. He has been supplying pretty much all of northern New Mexico with fruit for a number of years and is reaping

rich reward for his enterprise in setting orchards when nobody else had the courage.

For several months very careful prospecting has been going on to discover all the resources available to justify the construction of the railway between El Paso and White Oaks. The work has been very thoroughly done under the direction of Mr. Chas. B. Eddy. From the fact that purchases are being made and options closed for coal mines at Salado, and from other indications, it is believed the results are satisfactory and that the road will be built.

The contemplated International Dam at El Paso, Texas, which was referred to in our last issue, is causing some excitement among the residents of the Rio Grande Valley above El Paso, who are petitioning congress to consider the advisability of erecting the dam at some point higher up the river, whereby they, as well as the El Paso people, would be equally benefited. The matter will come before congress next session and is likely to attract considerable attention, not only to the International Dam itself, but also to the general question of government appropriations for the erection of dams for the purpose of reclaiming arid lands.

UTAH.

More than 100 carloads of very fine cattle are being shipped out from the range south of Moab over the Rio Grande and Missouri Pacific roads.

There is a pronounced movement in the Cache Valley in the direction of establishing dairies, and a packing house at Logan is also under discussion.

The movement of stock cattle to Montana and the Dakotas will be greater this year than ever before. At least 200 carloads are to be moved from southern Utah to Butte. Shipments will commence about June 1.

The Rio Grande Western is surveying a branch line from Provo to Park City, which it is expected will be built this year. In all parts of the state new enterprises are taking root, and railway extensions are incident to them.

Among the bills passed near the close of the legislative session just closed was one providing for the organization of drainage

districts. It is along the line of the irrigation district laws of California, which have become so generally well known. The last were, however, copied after the drainage district laws of the same state, which had preceded them.

WASHINGTON.

The spring was very late.

Yakima valley suffered by severe injury to the fruit buds by spring frosts.

A new creamery is being established at Wenatchee, the first one in that region.

Many new settlers are going into the Entiat valley. Work has commenced on the Entiat Company's ditch, and several hundreds of acres will be planted this year of the reclaimed land.

Paul Schulze promises to rank among the embezzlers, as H. H. Holmes does among murderers. He had previously been credited with stealing \$1,500,000 from the different enterprises with which he was associated, and now it appears that he got \$600,000 more from a St. Paul syndicate.

The Columbian Portage company is proposing to cut present railway rates in two but asking those who will be benefited by the reduction to take stock in the enterprise. It is wise to get the commitment before the building for the average citizen feels but little obligation to pay for that which he can get without.

WYOMING.

There have been distributed from the state hatchery at Laramie, 700,000 of brook and rainbow trout to different counties of the state.

Seventy-five families are settling in the Jackson's Hole country this spring. About one hundred families went there last year and have been successful in cattle raising and farming. Three troops of cavalry are within reach affording protection against the Indians.

Suit has been brought by Gibson Clark, U. S. district attorney, in the name of the United States, against the receivers of the Union Pacific Railway Company. Lands to the value of \$1,000,000 are involved. It is claimed that the railroad company sold lands as under its grant to which it was not entitled. Two hundred settlers are joined as defendants, but the railway company

will defend the suit for all parties concerned.

The state board of control is making provision for extensive surveys in all of the different irrigation districts of the state. Applications for leases were filled for about half a million acres of land. The state constitution adopts a minimum sale price of \$10 an acre, which is above its market value. As it leases at from five to ten cents an acre it is altogether better to lease than buy. There were about 275,000 acres under the government grant of state lands still to be selected. When the total is selected and leased, the state will get an income from it of about \$20,000 a year.

GENERAL MINING NEWS.

Under the new law in Utah the cost of incorporation papers is twenty-five cents on each \$1,000 of capital stock.

The old mine at Barnack, Montana, is being fitted up, and is to be started on ores from the mines of the camp.

A Utah mining man has invented the Acme Gold Amalgamater which is being tested at the Carrington bar on the Snake river.

Anaconda is to have a plant for the manufacture of sulphuric acid from the smelter smoke, for the present only for the company's own use.

The Salt Lake Tribune has recently published a twenty-four page, 300,000 edition, devoted to a detailed write-up of the prosperous Mercur camp.

American mines are again attracting a good deal of attention in London. Prominent experts and South African miners are coming to America this spring.

Superintendent Treweek, of the Mercur mine, says he is ready to increase the output of the bonanza to 1,000 tons a day any time the management provides for the handling of it.

There are at present eleven smelters running in Colorado. All of them are now receiving twice the amount of ore they received last year, indicating that the output is doubled.

The big copper plant that has been standing so long unfinished at Salt Lake City, because of factional fights among its

owners, is to be completed and put in blast by June 1 to 15.

While the DeLamar mine in the Mercur district, Utah, does not give out figures for publication, it is contended that it is producing more gold than any other single property in the country.

While sinking a well for water at Cerrillos, New Mexico, oil was struck at a depth of 110 feet. It was not in paying quantities, but the work is to be prosecuted in the hope of making a rich strike.

The Silverton Northern Railway is being constructed between Silverton and Mineral Point up the Animas valley, Colo. It will furnish shipping facilities for twenty gold-producing gulches, where there are many mines already in operation.

The Trail Creek district of Washington is coming to the front and will show a very heavy output before the close of the year. It is estimated that the average will not be less than 400 tons a day of \$40 a ton ore, or \$16,000 a day.

Placer mining will be prosecuted in all of the states with great vigor the present season. New finds are being made and new methods of saving the gold, so that the output promises to be a large factor in the total gold production for the year.

The Power Development Company in the Kern river valley, California, is expected to practically dry the river bed in seasons of low water, and many mining locations have been made along the riverbed with a view to placer washing at such periods. It is known that there is plenty of gold in there yet.

The most valuable single carload shipment of ore that has probably ever been made has recently been shipped from the Eureka Hill mine, Utah. Twelve and a half tons were valued approximately at \$375,000, there being sufficient gold in it to bring it up nearly to coin value. It was the product of the mine for about three months.

The district surrounding Baker City, Oregon, is becoming one of the important gold fields of the West, and development work is in progress there on a scale never before known. Capacity of mill and mining plants is being increased, new mills are being erected, additional men are

being employed and there is generally a wholesome condition.

The Mammoth Mining Company, of Utah, has recently struck a body of ore at the 800-foot level equal to that which gave the property its reputation in its palmy days. Much of it yields as much as 100 ounces of gold to the ton, and the silver ore yields as high as 1,400 ounces. Twenty new stamps are being added to the mill, making a total of sixty.

There are to be two cyanide plants constructed in the Mercur district, one by the Mercur and the other by the DeLamar, each with a capacity of 500 tons per day. Other mills are being built in the same district. The process is one calling for a comparatively small outlay in the plant. The ore bodies are enormous, and although of low grade the cost of treatment is so small as to leave a handsome margin of profit.

An article by Robert A. Kirker, published in the Grand Junction, Colorado, News, advocates the establishment in that locality of an Oberstein lapidary factory. He makes the broad statement, and challenges contradiction, that there is in that locality a superior quality of raw products of agate, onyx, jasper, chalcedony, etc., more beautiful and in greater variety of color, without flaws or imperfections, than can be produced by any other lapidary locality or manufacturing site now established in the old world or in America. His article is a very interesting one, and indicates a comprehensive knowledge of the industry.

The cathode ray is finding its adaptation for a great variety of purposes. Recently some very interesting experiments were made in Oregon City, Oregon, by Dr. J. C. Ferry, a well-known physician there, and W. C. Cheney, superintendent of the Portland General Electric Company. The rays were made to define the free gold in gold-bearing rock as plainly as if lying on the surface of the quartz. This is probably the forerunner to a general use of it in mining operations. If they go on improving it as they have for other purposes, it will not be long before we shall hear of it being used to explore the ground between tunnels and the surface above.

BOOKS AND MAGAZINES.

GLADSTONE, HALE, FARRAR, GUNSAULUS, ETC.

No matter what the subject might be on which the men whose names are given above might write it would be of absorbing interest to the people. How much more would this interest be if the subjects on which they wrote were those to which these men had given the greatest consideration and the best thoughts of their minds. In "The People's Bible History," just issued by the Henry O. Shepard Company, of Chicago, the matured opinions of these men—of the most learned Biblical scholars in all portions of the globe—is concentrated. Of this book Bishop John H. Vincent says: "What Gladstone and Sayce have written expressly for its pages, giving the latest results of their largest knowledge, is enough to justify even the most cultivated people among us in the purchase of this admirable book, and the English ex-premier and the eminent English archæologist are only two out of eighteen specialists who have contributed to 'The People's Bible History.'" The beauty and wealth of illustration and the exquisite presswork and typography of the book are worthy settings to the utterances of the great minds set forth in its pages. The popular edition of the book is to be had in cloth, half russia and full russia. Agents are wanted. An edition de luxe has also been brought out, containing 1,283 pages and 200 full-page illustrations and maps, and is said to be a masterpiece of modern bookmaking.

"The Education of Women in Turkey" is the interesting theme of an article by Miss Mary Mills Patrick, President of the American College for Girls, Constantinople, whose educational work among the women of Turkey, extending over a number of years, entitles her to write with authority on this question. Professor Thomas Davidson, who has just returned from a two-years' sojourn in Europe and the East, has written a highly interesting article for this number entitled "The Democratization of England," for the June Forum.

An entirely new near view of Grant will be given in McClure's Magazine for June, in a paper written by the man who was chaplain of the Twenty-first Illinois when

Grant was colonel of the regiment, and who lived during that time in the closest intimacy with him. It reports interesting conversations with Grant and relates a number of characteristic anecdotes. In this number Elizabeth Stuart Phelps will have a paper of reminiscences of Harriet Beecher Stowe, who was her neighbor and helpful friend in Andover, and of James T. Fields, her literary adviser and publisher. The paper will be illustrated with some rare portraits and other pictures.

With its rubricated initials, its fifty beautiful illustrations—of which six are in a rich photo-tint—its marginal decorations and interesting letter-press, the Land of Sunshine, of Los Angeles, California, is very much the most attractive number yet issued by that progressive magazine of the great Southwest. The romance and mystery and beauty of California, Arizona and New Mexico find in this handsome monthly such expression as they have never had before. Pictorially it is much ahead of anything else in the West; and it is made to be read as well as looked at. Its contents are crisp, competent, characteristic and always readable. The best writers in the West (and some of the best in the East) are among its contributors.

The second article on "The Trotting Horse," by Hamilton Busbey, in the June Scribner's, contains more remarkable illustrations of great trotters. Among the most beautiful in this issue are Sunol, Azote, and Electioneer. The great stock farms of Stony Ford and Palo Alto are also described and illustrated.

The wombat is a little animal resembling in appearance a small bear, with short legs, a broad, flat back, and very short tail. It eats grass and other vegetable matters and is a harmless little creature, shy and gentle in its habits, though it can bite if very much provoked. In the May "Chatterbox" there is a story of a farmer who had a wombat for a pet; he took it a long way into the forest in order to get rid of it, but twice the little animal returned, having found its way without help to its adopted home. The third time the farmer conveyed it across a deep and broad river, and as the wombat cannot swim, he felt sure he had gotten rid of the persistent

pet; but no! the little creature soon found a huge fallen tree, which lay half across the stream, and crawling to the extreme end, sat wistfully gazing at the departed farmer. So touched was the man that he paddled back again, took his fat little passenger on board, and carried it home, much to the delight of the children.

[ESTES & LAURIAT, publishers, 196 Summer street, Boston, Mass., fifty cents a year or three months for ten cents.]

A COLORADO RANCH.

The Wallace Ranch in Colorado is eight miles east of De Beque on the south side of the Grand river. It consists of 480 acres all in a fine state of cultivation, watered by a mountain stream which furnishes abundance of water for irrigation. This stream has its source on the high table mountain known as Battlement Mesa. The top and sides of the mountain are covered with grass and timber. The grass of which there seems an almost unlimited supply is used for the pasturing of domestic cattle, and the timber furnishes shelter for plenty of large game such as elk and deer.

From the top of a near by mountain can be seen toward the east the snow-covered peaks around Gunnison and Aspen, while to the southwest can be seen the LaSalle and Henry mountains in Utah.

This ranch is just at the gateway where the creek has forced its way through the mountains and out on to the level mesas, where there is fine farming land only waiting the magic touch of water and cultivation to blossom and bring forth abundant harvests.

The best method to grow corn in one locality may not be the best in another. Careful study must be given to the local conditions. For this as well as for almost everything else the farmer has to do, it is necessary to give careful thought.

It takes less time to keep the chickens and stock healthy by preventing the sickness than to cure it, and costs less, too.

A fresh cow in lambing time will beat a creamery for profit.—Dakota Farmer.

Weeds are robbers of plant life. Exterminate them.

MANUFACTURES AND TRADE

FOREIGN COMMERCE OF THE UNITED STATES.

From official sources we collect the following statistics showing the volume of our foreign commerce for a series of years:

	Exports.	Imports.	Total Commerce.
1889.....	\$ 742,401,375	\$745,131,652	\$1,487,533,027
1890.....	857,828,684	789,310,409	1,647,139,093
1891.....	884,480,810	844,916,190	1,729,397,000
1892.....	1,030,278,148	827,402,462	1,857,680,610
1893.....	847,665,194	866,400,922	1,714,066,116
1894.....	892,140,572	654,994,622	1,547,135,195
1895.....	808,050,419	743,742,849	1,551,802,259

The figures given are for the fiscal years ending with June 30, and it will be seen that our foreign commerce attained high water mark during the year ending with June, 1892. A change of tariff schedules has taken place during the time under review, and a violent convulsion in the financial world has also occurred; yet all causes combined have not so very seriously crippled our foreign trade, as the above figures will testify. The ultimate effects of recent tariff legislation cannot yet be foreseen, but they are almost certain to increase the imports if they do not diminish the exports.

SOUTH AFRICAN MINING IN A NUTSHELL.

Probably not since the days of John Law and his celebrated "Mississippi Scheme," has the general public of England and France especially, gone into wilder or more hopelessly reckless speculation. The mining stocks of the Johannesburg region in South Africa formed the basis of innumerable wildcat concerns which have drained dry the stock markets of both England and France. Beyond a certain point, however, sensible people who stop to think a bit, know the whole business to be insane folly. Any-one reading the following figures from the London Statist, reprinted here from Bradstreet's of recent date, can see at a glance how hopeless is the prospect of dividends from West Kaffir mining shares: "At the end of 1893 the capitalization of the Witwatersrandt mines, on the basis of the market price of the shares, was about £17,500,000, the return in dividends £1,000,000. At the end of 1894 the capi-

talization was about £55,000,000, and the return in dividends about £1,500,000. The present capitalization of the whole of the mining companies having their field of operations in South Africa cannot be far short of £300,000,000, while the actual dividends for 1895 were not more than £2,500,000." Certainly, dividends of only five-sixths of one per cent. should not be very enticing to investors, even in these days of low interest.

SOMETHING ABOUT BANANAS.

It is believed by many lovers of bananas that if they could only eat the fruit directly from the plant they would find it incomparably more delicious. This is an error. Even on the plantations where grown, bananas are never allowed to ripen on the stalk. Like our pears, the banana is much better if taken from the stalk when mature, but not ripe, and allowed to ripen elsewhere. The banana stalk bears but one bunch of fruit, and is always cut down in harvesting that bunch. "Suckers" continually spring up from the roots of the banana, hence the crop goes on, one sucker after another coming up to bear its bunch of fruit after those preceding it have been cut down in the process of harvesting. The main sources of supply for bananas coming to the United States are Jamaica and the eastern coast of Central America. From Port Limon, in Costa Rica, a good many thousand fine bunches come in every year, and also from the region of Bluefield and the Escondido river, in Nicaragua. But the largest shipments are from Jamaica. For the year 1894 the value of bananas imported was \$4,960,747; and for 1893 it was \$5,386,029.

FREE ENTRY OF FOREIGN FRUIT BOXES MADE OF AMERICAN MATERIAL.

Everything seems to be interpreted in favor of the foreigner when it comes to the construction of our present tariff law. Not long since the Board of Appraisers at New York, who knocked the duty off Grecian currants recently, made the fol-

lowing ruling regarding foreign orange, lemon and lime boxes made of American shooks:

"In view of this doubt as to the proper construction of the law, the rule would obtain, as often announced by the Supreme court, that the benefit of the doubt should be resolved against the government and given to the importers. This would authorize the conclusion that imported orange boxes, which are made entirely of American shooks, previously exported filled or empty, would be free of duty under said paragraph 387.

"This construction we accordingly place upon the law, and, in harmony with such interpretation, we modify decision in *re Haynes*, G. A. 2855, sustain the protests and reverse the collector's decision in each case, with instructions to reliquidate the entries accordingly."

The effect of this ruling will be to lower the duty on foreign citrus fruits a few cents a box, thus still further cutting into the American producers of these fruits. Perhaps the day may come when we shall have a tariff law specially favoring American producers as against foreigners. At present the latter appear to have things very much their own way.

COTTON SPINNING IN JAPAN.

Statistics published recently by the government of the United States show that in 1887 only 19 cotton spinning factories with 70,220 spindles were to be found at Kobi, Osaka and vicinity; while in 1893 there were 40 establishments numbering 381,781 spindles, and producing 87,667,324 pounds of cotton yarn. In 1894 the output was 90,000,000 pounds. In February, 1895, there were 47 cotton spinning establishments, with 492,979 spindles and the number is liable to be greatly augmented in the near future. Up to 1894, the value of spinning machinery for cotton and silk imported into Japan was \$1,445,000. It is of interest to note that in Japan, male cotton spinners receive but 8 cents a day while female operatives get but 5 cents a day. Some day our own spinners as well as those of Great Britain will have to compete with the 5-cent spinners of Japan.

The wettest place in the world is Cherrapongee, in India, the annual average rainfall there being 610 inches. In 1861, the downpour at that point reached the mar-

velous figure of 905 inches. The average annual rainfall for the globe is 36 inches, and the mean annual temperature is 50 degrees Fahrenheit.

The hottest city in the world is Calcutta, India, where the mean annual temperature is 82.4; the coldest inhabited place is Tobolsk, Russia, with a mean annual temperature of 32. The average temperature of St. Petersburg is 39.6, and of Moscow, 40.

The line of perpetual snow under the equator is 15,260 feet above the level of the sea. In latitude 70 it is but 1,278 feet above sea.

In spite of the fact that we hear continually that Australia is overrun by rabbits, they are quoted in the Melbourne market at 24 cents per pair, and hares range from 24 cents to 36 cents each. These prices are quoted by United States Consul Maratta.

Consul Germain, at Zurich, Switzerland, reports to the State Department that the female operatives in the knitted underwear factories in Switzerland get an average of 29 cents per day. He visited a factory employing about 500 girls and women at these wages, and was informed by the proprietor that each of them had an account in the savings bank. Large amounts of this underwear are imported into the United States from Switzerland.

Mulhall, the great English statistician, alleges that at the death of Augustus Cæsar, the population of the earth was but 54,000,000. That of Europe before the fifteenth century did not exceed 50,000,000. The world's population is now estimated at 1,479,729,400, that of Europe being 357,379,000.

The Royal Geographical Society of England gives the earth's area at 196,971,984 square miles, and its cubical contents at 259,944,035,515 cubic miles.

One-quarter of all the people born upon the earth die before reaching the age of six years; one-half before reaching the age of 16, and only about one person in each 100 born lives to the age of 65.

H. C. Welty, of Topeka, Kansas, one of the most prominent well-drillers in the State is an advocate of irrigation by means of wells and pumps and wherever possible by artesian supply. Mr. Welty was the organizer and moving spirit in the Well-drillers' convention last year.

TOPICS OF THE TIME

Mutual Interests. There are no two classes in the community whose interests are so intimately woven together as the manufacturer and the farmer. The one cannot prosper without the other does. That the farmer has suffered out of proportion with other classes during the past few years any one who has given study to the matter is compelled to admit. At present prices for farm products the return for the farmer's labor is rarely enough to provide the absolute necessities for his family. Opinions may differ as to the cause of low prices, but the farmer of the west believes it is largely due to the manipulations of the world's financial markets, by which silver has been depreciated in price relative to gold. So long as the surplus of farm products seeks a foreign market, the price of that surplus in great measure regulates the price of the entire product. If we sell our silver bullion as a commodity for half its former price, and it can still be used as money to buy farm products in other countries in the same quantity as at its former price, it goes without saying that our farmers must compete with those products and must, therefore, accept half price for what they raise. It will not help the manufacturer very much to give him any measure of protection by tariff unless at the same time the great mass of his customers are put in a position to purchase and consume his wares. The principle of protection is not one that should have simply a local application. Every industry should have its due recognition, and where there is such pronounced mutual dependence there should be equally a mutual help, in behalf of such legislation as will promote the interests of all.

Official Reports. It is a highly commendable work that state engineer Mills is undertaking to do for Idaho. He has sent out over the state hundreds of circular letters accompanied by blank forms to be filled out by the parties addressed. The information so obtained will be compiled as official agricultural statistics of

the state. Heretofore there has been no advertising of the state's resources except by persons interested in colonization. A detailed statement of facts is expected to show that the average yield of nearly all kinds of farm products, in all parts of the state, is much in excess of the average yield for the United States, and coming from a state office it will have much greater weight of authority.

Emigrant Movement. The number of emigrants who arrived in this country in 1892 was 623,684. It gradually decreased until 1895 when it was only 279,948. In February of this year the increase began and since then the people have been pouring in at such a rate that Colonel Stumpf, commissioner of immigration at Washington, prophesies that the number this spring will equal, if it does not exceed the record of any previous year. There is also a very heavy movement from east to west, and the movement which has been anticipated for the past two years, as the logical result of the business depression, promises to reach the full tide during the present year.

Lands are Taxable. The United States Supreme Court has confirmed a decision by the state courts of Nevada holding that the state is entitled to levy taxes upon patented lands, and also for lands which have not yet been patented, but which had not been surveyed, and on which the cost of surveying had not yet been paid. It holds that if the railroads have a possessory claim to the lands they are taxable under the statutes of Nevada.

Educational Agencies. The first thing asked and obtained of the state legislature of Utah, in the farming interest, was an appropriation of \$1,500 for the support of farmers' institutes. It may be difficult to determine which is most valuable, the agricultural experiment stations, fostered and aided by the government, or the institutes which are a state

institution, and there is certainly no occasion for rivalries. Both are doing splendid work and in thoroughly practical ways. Money spent for either will bring prompt and large return in developing to best advantage the vast agricultural resources of the state.

Quick Recovery. The orange trees which were cut down by the frost in Florida are making a wonderful growth of wood and the trees will bear a fair crop in two years, instead of losing five as was at first expected. Such rapid growing wood, will, however, be more susceptible to similar injury than the old wood of slower and sturdier growth.

Delayed Decision. It has been for some time expected that a decision was to be rendered in the United States Supreme Court as to the constitutionality of the Wright irrigation act, and the validity of bonds issued under it. Intimations have been given from some source that the court will uphold the act, and it is stated that a New York capitalist has been buying up the bonds at low prices, with the expectation of course that they will advance in value. A decision upon this question involves a very large aggregate amount, and it would be deplorable if a decision should be so long withheld after the arguments had been made, and at the same time there should be a leak which would justify such a speculation. It is to be hoped that the man is only a good guesser.

Important Decision. The Caldwell Tribune says of a recent decision handed down by Judge Richards, of an Idaho district court:

"This decision goes specifically to the question of perpetual rights and while it does not inhibit the sale or purchase of them it amounts to practically the same thing by holding that canal companies must supply water to settlers, at reasonable rates, without perpetual rights, when there is surplus water in the canals. In other words, according to the decision, the canals are common carriers just the same as railroads and the public is not obliged to pay a royalty for the right to engage their services. If the supreme court sustain the district court, which we

think it will, one of the worst evils in connection with the commercial irrigation system will have been done away with. The canal companies then will not be privileged to say, we will furnish water under such conditions as suit our purposes, but they will be obliged to furnish water under such fair and equitable regulations as the courts may determine. If this is the law, the question occurs, has it not been the law ever since the adoption of the state constitution? If it has, may it not open an interesting question on the subject of desert lands? After a canal has been constructed for the purpose of supplying a body of unoccupied public lands, does not that tract cease to be desert land except as to the particular person or persons who constructed the canal? Has the general public right of desert entry when it can be shown that the land is under water which may easily be diverted? It seems to us that under the decision of the land department in the case of the People's company against the American Falls company there might be serious question on this point. However, the water question is gradually working itself out in correct lines and it will soon be numbered among the things that no longer harass and retard development of this magnificent section of the great west."

A Sure Prevention. Chauncey Depew talks on many and varied subjects and generally talks well. His tongue often runs very smoothly with its flattery, and he seems to have given it full play during his recent Pacific Coast trip. In Southern California he said:

"Here is a country destined to drive Italy and the world out of oranges, olives, prunes and wines. Here is a land that will rejuvenate the worn out pilgrim from the far east, and more. Heretofore there has been one dread disease from which no rank or condition has been exempt, but by your seedless Navel oranges you have robbed the race of the terrors of appendicitis."

Consolidated Salesrooms. Gradually the fruit growers of California are improving their market facilities. Between a monopolistic railway which has demanded all the traffic will bear and the

combinations of the packers, who have not been bashful in making their demands, the fruit growers have been producing the fruit just for the fun of the thing, as it were. But the natural law of self-preservation is asserting itself, and by fruit exchanges and other organizations the growers are getting together and are taking the reins in their own hands. They are packing their own fruits and shipping it to their own agencies in the principal cities, and are establishing a market for their well-protected brands. Recently there has been a movement to hold auction sales in three separate rooms at the same time in the Chicago market, thereby dividing the buyers into small groups, restricting competition and holding prices down in the interest of the local purchasers. The Sacramento Fruit Grower's convention appointed a committee of the leading growers to consider the matter—H. Weinstock, of Sacramento; Joseph Martin, H. A. Fairbanks and Wm. Johnston, of Courtland; A. T. Hatch, of Suisun; R. D. Stevens, of Sacramento; and Frank H. Buck of Vacaville. They decided unanimously that consolidated auction salesrooms should be established at all the eastern markets, to bring buyers under one roof and stimulate competition.

Security Authorized. The Senate committee on public lands reported an amendment to the sundry civil bill by which a basis of security is established, through the state governments, for money expended in reclaiming lands under the Carey law, by issuing patents and authorizing liens upon the land. It may be said here that there seems to be a willingness on the part of congress to adopt any reasonable measure which will assist the reclamation of the lands for which that law was intended, and it is being amended so as to make its execution less difficult.

The Country in Miniature Senator Cannon, of Utah, has introduced a resolution in the senate providing for the creation at the national capital of a physical map, which will be two-thirds of a mile long and of a width in due proportion. It is to be laid out on the ground, reproducing every physical feature of the country, including every

lake, river, hamlet, city, railroad and canal, mountain and plain, in miniature, on a scale of a foot square to the square mile. If it can be carried out our national legislators can get a better appreciation of the relative size and importance of the states than most of them possess. It is doubtful, however, whether the eastern people will be willing to make the contrasts so conspicuous.

Planting Trees. The State of Michigan has furnished a large share of the lumber used in the construction of farm buildings and fences in the prairie states east of the Mississippi, and is just now beginning to realize that there ought to have been more trees planted as the grown forests have been cut away. Governor Rich issued a proclamation urging that every person in the state should plant at least one tree on May 1st, if it was at all practicable, and that the public schools make observance of "arbor day." He also pointed out the desirability of preserving shade trees along the public roads. It is better the harm be remedied by action in the future than not at all, but foresight which would have prompted it many years ago would have been most commendable.

Object Lessons. If every fruit grower who depends on shipments of his products to the great city markets could follow his consignment and note the treatment it gets from the transportation companies, or their employees, it would impress upon his mind the necessity for careful packing to prevent injury by rough handling and neglect at transfer points. If then he would go into the market houses—the commission houses—and see the pressure under which sales must be made and the stuff handled, and how large a proportion of that which reaches the market is in a damaged, and sometimes in really unsalable condition, it would probably be the best investment he could make in connection with his business, both of time and money. There is always demand for good fruit in good condition, but if it is of inferior quality and is badly packed, and consequently in bad condition when it arrives, it is far better to keep it at home and feed it to the pigs.

POINTS FOR PRACTICAL IRRIGATORS

SAND IN IRRIGATING DITCHES.

A correspondent writes for some information upon the best method of preventing a main irrigating ditch from being filled up with the sand and silt that is present in nearly all the streams to a greater or less extent, especially during the winter season.

There are two ways of doing this: By watching the flow of any stream it will be seen that the greater portion of the sand, and that which will cause the most damage if allowed to get into the ditch, is carried at the bottom of the stream in a mass which moves with less rapidity than the water over it. To prevent this moving mass from entering the head of the ditch the headgate should be arranged so that the bottom boards are considerably higher than the bottom of the stream. Planking should be put in perpendicularly across the gate, against which the sand flow will strike. Of course if there is no outlet the sand will quickly accumulate so as to clog the gate. To obviate this difficulty, at one side of the gate put in a waste weir having its base lower than the base of the headgate. Then arrange the gate in the weir at a height just sufficient to allow the sand to be carried away and not permit more water to escape than is necessary to carry the sand.

Of course it will be necessary to give the waste weir plenty of fall before its discharge, else it too will clog up. When an unusual amount of sand is carried into the stream by reason of a storm it is desirable to shut down the headgate entirely until the most of the sand flow is over. But this cannot always be done.

Another way to keep a ditch clear that has a good fall is to put in waste weirs and gates at regular intervals. Then if the ditch begins to clog up, shut down the first gate, open the weir and let the current scour out the ditch. When the first section is cleaned, open the gate and close the next one, and so on until the ditch is all worked out. This plan is in use in Arizona and proved very effective.

But the best way is, if possible, to prevent the sand from accumulating in the ditch, and this can be largely done by the method outlined.

MACHINERY FOR IRRIGATING AND DRAINAGE CANAL.

The accompanying cut illustrates a 11-4 Ditching Dredge manufactured by the Marion Steam Shovel Company of Marion, O. This company makes a specialty of Dredges, Ditchers and Steam Shovels. Their attention is exclusively given to this line. Their plant covers 11½ acres of ground, and is equipped with everything in the way of modern machinery that will cheapen, or better the production. Their power is electricity which is generated in the power house and transmitted to the different departments in each of which is a suitable motor.

There is an interesting history connected with the work on which the Dredge illustrated was used; it was used on the Mesa Canal in Arizona. This canal is part of a system of canals that modern engineers claim was first made by a prehistoric race; they also claim that the system was so nearly perfect in all its details that modern engineers have been able to improve on it only in a few instances. When, and by whom it was

constructed, there is no record. Many parts of this system were nearly or quite filled up; but, when cleaned out, the old channel could be plainly traced. In deepening and widening this system of canals, very hard material was encountered—much of it being shale rock, and cemented gravel. Many large boulders were found that had to be removed with the dredge. At the point where photograph shown, was taken, the material was hard cemented gravel. The Marion Steam Shovel Company sold a little later on to the same company a very large dredge, capable of depositing the material at a distance of about seventy-five feet from center of machine. This made the equipment of this canal company complete, as they could construct new extensions, or clean out the old channels, be they either large or small, with machinery. It is a fact no longer disputed, that canals are much better when constructed by machinery, than when constructed by old-time methods, for the reason that they do not require so much slope and consequently there is not as much room for grass, weeds, or bushes to accumulate along the banks and obstruct the flow of the water. A large per cent can also be saved on the cost of construction by the use of suitable machinery.

LIDGERWOOD CABLEWAYS.

Spencer Miller, engineer of the Cableway department of the Lidgerwood Manufacturing Company, New York City, has returned from a four-months' visit to Europe much improved in health and bringing with him all the American rights under the patents of the Temperley Transporter which the Lidgerwood Company will immediately place upon the market.

The Transporter is a hoisting and conveying device employing a suspended beam as a trackway. The chief points in its favor are simplicity in operation, low cost and extreme flexibility. No skill whatever is required to operate this apparatus.

About 300 transporters have already been made and the device has therefore passed through its experimental stage.

The British Admiralty have adopted the Temperley Transporter for coaling battleships, having recently purchased nearly one hundred of them. Mr. Miller

also secured a contract in Paris from the New Panama Canal company for seven cableways which were shipped April 30, to Panama.

COMMON SENSE IN ADVERTISING.

The advertiser who goes around seeking avenues for announcing his wares to the world, unless well grounded in the basic principles of the art, is apt to be most gloriously fooled. He will soon find himself and money parting company. If he looks only to quantity in advertising, his separation will come all the quicker. It is a comparatively easy matter to place advertising on the quantity principle, all that is required is the ability to add figures and compare statements. But it is quite a different matter to decide on advertising lines on the standard of quality. There are mediums having a very limited circulation which are to be preferred by a thousand per cent. to those claiming a great distribution of copies, rates being equal. Character of the publishers and reading matter, size and distribution of a subscription list, uniformity of rates and general business methods have much to do with an intelligent selection of an advertising medium. Then, sad to relate, publishers have little tricks which deceive the advertiser, making him believe he is getting "results," when he is simply answering letters from "stool pigeons" placed in different sections of the country to incite the unsuspecting advertiser into the belief that he is having great "returns." That species of wickedness cannot be laid at our door.—*Am. Investments.*

POINTS.

Even in Dakota irrigation doubles the grain crop, and it pays to sink artesian wells to get the water supply.

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Are the most reliable
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for

Pumping Water for Irrigation

Catalogue Free.

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YOU CAN DO IT WITH A

MENCE PUMP

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Lightest Running
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Joints; nothing to
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VOL. X.

No. I.

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THE INTERNATIONAL DAM AT EL PASO, TEXAS.

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The attention of *Irrigation Companies* is called to this **CELEBRATED WATER WHEEL**, as particularly adapted to their use, on account of its *remarkably steady motion, high speed and great efficiency* and *large capacity*, for its diameter, being *double the power* of most wheels of same diameter. It is used by a number of the leading *Irrigation Companies* with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent. of useful effect *guaranteed*.

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A Rife Ram at work irrigating, etc.

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Engine	10	1	$\frac{3}{4}$	4 to 5	$2\frac{1}{2}$ to 3	5	125	\$50 00	\$65 00
"	15	$1\frac{1}{4}$	$\frac{3}{4}$	6 " 12	5	8	150	55 00	70 00
"	20	2	1	8 " 16	7	2	200	60 00	75 00
"	25	$2\frac{1}{4}$	1	10 " 24	11	2	225	66 00	81 00
"	30	3	$1\frac{1}{4}$	12 " 36	15	2	250	75 00	90 00
"	40	4	2	15 " 75	30	2	350	120 00	140 00
"	60	8 OR 10	4 OR 5	150 " 350	150	3	3000	450 00	500 00

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Mention the IRRIGATION AGE.

THE IRRIGATION AGE.

VOL. X.

CHICAGO, JULY, 1896.

NO. 1.

IRRIGATION TRUSTS IN VICTORIA.*

CHAPTER II. NATIONAL WORKS.

BY FRED CAMPBELL, C. E.

IT has been stated in the preceding paper that when a scheme for establishing a trust or trusts came before Parliament, certain portions of the proposed works, on the recommendation of the Minister for Water Supply and his technical advisers, could be denominated "national works;" these would then be constructed at the cost of the State. It is now proposed to describe these works.

In comprehensiveness of design, in magnitude of works and in area of irrigated land commanded, the Goulburn Weir comes easily first. The Goulburn, a tributary of the Murray, is the largest of the Victorian rivers, and takes its source in high mountainous country, some of the peaks reaching an altitude of 5,000 and 6,000 feet. The area of its watershed above the weir is 3,940 square miles, and as the bed rock, a dense, close-jointed schist, lies near the surface over a large extent of the watershed, the proportion of total rainfall discharged into the river is large. The river basin below the weir comprises a further area of 2,500 square miles, and is composed of alluvial plains of deltaic origin. The weir is constructed just above where the country changes to alluvial flats from low ranges, and it was to provide a steady water supply to the rich deltaic flats during summer droughts that induced the state to undertake this large work. From careful observations of rainfall and river gaugings carried out over a period of nine years, it has been ascertained that the proportion of total rainfall over the catchment area,

passing the site of the weir, varied between 18 per cent and 37 per cent, the average having been 29 per cent.

Various reports from the Department of Water Supply were presented to Parliament, on the construction of a storage basin and regulating weir on the Goulburn river, and finally, in 1886, Parliament authorized its construction. By the middle of the following year a contract had been let and work commenced.

DESCRIPTION OF THE WORKS.

The rock, forming the foundation of the weir and extending under the bed of the river and up both banks at a small depth below the surface, is a soft shale of the upper silurian formation. Its structure is alternating beds of sandstone, slate and pipeclay, standing on edge almost vertically. The weir is 695 feet in length, exclusive of the space occupied by channel regulators—a further length of 230 feet—and the summer level of the river is raised by it about 45 feet.

The main part of the structure is of concrete masonry, composed of broken stone, clean washed gravel, sharp sand and Portland cement. It is backed by granite steps for its full height and notched into that below. While the superstructure was in progress, the water was carried by six tunnels left in the lower portion, each of forty-four square feet section area. These were permanently closed by heavy cast-iron gates, when the upper works had been completed. During the course of the works a heavy flood totally submerged them, but without doing any damage.

*All rights reserved.

The weir is built of large blocks of concrete bonded as in ordinary masonry and laid in cement mortar. This course was adopted in preference to the ordinary method, as it was considered that should a crack start, there would be less danger of it traversing the structure from top to bottom than were it monolithic.

The waterway in the upper portion of the weir is occupied by twenty-one flood-gates, each having a clear opening of twenty feet by ten feet. These are lowered into recesses or chambers in the body of the work, and can be so adjusted at any time as to maintain a constant level of water in front of the offtakes. Wrought iron ribs and braces have been worked into the concrete in front of the gate chambers to strengthen it at these points.

The gates which are framed of wrought iron beams filled in with cast-iron plates, each weighing about seven tons, are worked by screw gearing. The gate pillars are of cast iron, hollow and filled with concrete. They are strongly secured by anchor plates and holding down bolts, and occupy about two feet of the waterway. The gearing for raising and lowering the gates is actuated by three thirty and a half inch "Leffel" turbines. These can be worked together or separately, and anyone or all three can be put in gear with any gate or gates. Hand gearing is also provided in case of emergency. A separate turbine drives generating machinery for electric light consisting of five arc lamps. These are necessary in order that the gates may be adjusted at night should the height of the river fluctuate.

REGULATORS.

In continuation of the weir are two regulators for the channel offtakes, one on the east and one on the west. These are of similar construction to the weir and are provided with cast-iron gate standards which also carry a light bridge. The western regulator has fourteen gates, each nearly ten feet clear opening with a height of seven feet. The eastern regulator has only four gates of similar dimensions.

CHANNELS.

In connection with the weir, a channel upward of twenty miles long has been excavated, from which the trusts to the west of the Goulburn river derive their supply. The bottom width of this chan-

nel is 110 feet and side slopes of one and a half to one. The gradient is six inches per mile, and it has a carrying capacity of 103,400 cubic feet per minute when running full. The eastern channel has not yet been constructed; it will be of much less capacity than the western. When both channels have been constructed it is estimated that 125,000 cubic feet per minute can be sent down during five months of the year, and assuming the construction of certain subsidiary storage basins, a total area of 416,000 acres can be irrigated to a depth of fifteen inches, after allowing a large margin for evaporation and infiltration.

COST.

The total expenditure on this splendid work to date has been £491,000 (\$2,455,000). Maintenance expenses come out at about £2,500 (\$12,500) a year. Part of this sum has been used in lining portions of the channels which are of earth. Indeed, maintenance charges should be a minimum on a work of this substantial character.

The foregoing description has been largely taken from a descriptive memorandum of the weir, compiled by the Chief Engineer of Water Supply, Mr. Stuart Murray, under whose supervision the works were designed and executed.

LAANECOORIE WEIR.

This weir is situated on the Loddon river about half a mile above the township of Laanecoorie, and is for the purpose of impounding and regulating the flow of water in that stream. No channels are in direct connection with the weir, which is solely used for regulating the supply in the river bed itself, the offtakes to the trusts' channels being some twenty miles lower down. Six trusts are dependent on the water here conserved for their supply.

DESCRIPTION OF WORKS.

The portion of the structure in the river channel itself is of concrete, with automatic lifting gates for the discharge of heavy flood waters. There is an extension on the left bank in the form of an earthen dam, protected in the rear by a banquettes of materials not liable to scour, and on the face by broken stone up to within six feet of the permanent water level, above that with concrete pitchers. The length of crest of main weir is 324 feet, provided

with twenty-four large and a similar number of small, automatic tilting gates arranged alternately. The water is raised by this means about thirty-two feet above summer level.

Through the body of the structure are four tunnels fitted with valves actuated by screw gear, by means of which the discharge is regulated, so that a continuous supply of water is permitted to flow down the bed of the river to the offtakes of the trusts' channels.

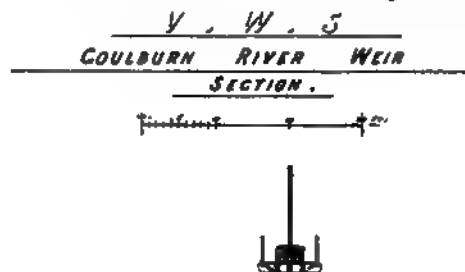
The automatic gates are of cast iron, and are based on the designs of Chaubart, a

acting in a satisfactory way. Hand gear is provided in case of the gates jamming.

The amount of water conserved is 610 million cubic feet. This with the ordinary summer flow of the river is sufficient to irrigate 40,000 acres. On this important work £133,000 (\$665,000) has been expended.

KOW SWAMP STORAGE BASIN.

A natural depression adjacent to the Murray river and supplied by the Gunbower creek, has been taken advantage of to form a storage basin from which can be



SECTION OF GOULBURN WEIR.

(From drawing made especially for THE IRRIGATION AGE.)

French engineer. They are set back at an angle of 9° with the vertical, are hinged about the center of pressure on a toothed sector carried on concrete pedestals, and are so balanced that when the water is flowing about a foot deep over their top edge, they tilt, thus automatically giving a very largely increased waterway for the discharge of flood waters. The small gates are arranged to open before the larger, so permitting of a gradual increase of waterway. Some trouble was experienced at first from trees, etc., carried down by the floods, fouling the gates. These difficulties appear to have been overcome, as the engineer in charge reports that they are

irrigated a large area of country. On the river Murray a timber head sluice resting on piles has been constructed. This is provided with iron regulating gates and screens, the former being manipulated by hand screw gears. When the river rises a few feet above summer level, water enters the sluice and is thence carried for a distance of seventeen miles, partly in a new channel and partly along the course of the Gunbower creek which has been straightened and otherwise made available for the purpose, to the Kow Swamp storage basin. The channel has a bed width of sixty feet, depth of eight feet and a fall of three inches per mile, and it is computed will

V. W. S.
COULBURN RIVER WEIR

ELEVATION

AUSTRALIAN ENGINEERING.
 (From drawings made especially for THE IRRIGATION AGE.)

discharge 40,000 cubic feet per minute. Breast dams and discharging weirs have been constructed where necessary along its course. Round the northern end of the swamp an earth dam five miles long has been made, partly to increase the storage capacity of the basin and partly to carry a small channel, discharging directly into the main distributing channel, on the further side of the reservoir. In case of an emergency, water can thus be led at once from the river to distributing channel without passing through the storage basin. The capacity of this channel is 40,000 cubic feet per minute, and is provided at its offtake with the necessary regulating sluices and gates.

The storage basin is capable of retaining 1,478 million cubic feet, and has an area of 6,850 acres, with an average depth of six and three-fourth feet. The outlet works consist of an open cut three-quarters of a mile long, furnished with timber sluices and regulating gates leading into the distributing channel. This has a bed width of thirty-six feet and depth of four feet and has been excavated to a gradient of three inches to the mile. Along its course are various road bridges, drainage culverts, etc. The length of this channel is about twenty-three miles to the Loddon river, under which it passes by means of a pipe syphon. Regulating and relief sluices are provided at this point. As practically the whole of the water of Loddon river is diverted above this crossing to supply various trusts, compensation water to the ex-

tent of 500 cubic feet per minute is allowed to pass into the river from the channel to supply property holders and townships below. Between the storage basin and the Loddon river a considerable area of country to the north is irrigable from this channel. After passing the river the water is discharged into the various trust channels deriving their supply from the Kow Swamp works.

LAND COMMANDED BY WORKS.

The gross irrigable area commanded by this scheme is 130,000 acres, but as at present constituted 50,000 acres can be watered in winter, and it is estimated that enough water can be stored to irrigate 25,000 acres in summer.

COST OF WORKS.

The total cost to date has been £175,000 (\$875,000) and the maintenance expenses work out at about £1,500 (\$7,500) per annum.

So far the government has charged the trusts nothing for the water supplied by these national works. It is intended, however, as the trusts become financially stronger to make such charges as will pay for maintenance, interest on the cost of construction, and provide a sinking fund to recoup the State for its expenditure.

The writer desires to express his indebtedness to the Chief Engineer of Victoria Water Supply and his officers for much information, freely given, in regard to the foregoing works.

THE PROPOSED INTERNATIONAL DAM.*

BETWEEN THE UNITED STATES AND MEXICO.

THIS matter is likely to engage the attention of Congress at the next session, and will involve entirely new questions of international law as regards priority of water rights on international streams, which will not only be of peculiar interest for their own sake, but are sure to bring up the whole question of the Federal control of interstate irrigating streams.

The history of the present case com-

mences in the year 1549, when the town of Ciudad Juarez was settled by the Spaniards on the right bank of the Rio Grande, just opposite the present town of El Paso, Texas, at which point the river crosses the southern boundary of the Territory of New Mexico, and from hence on, forms the dividing line between Texas and the Republic of Mexico.

For more than 300 years the Mexicans

* Prepared from data furnished by John S. Barnes, of El Paso, Texas.

of Ciudad Juarez have used the waters of the Rio Grande both for domestic and irrigating purposes, and so far as any law, custom or equity goes, they undoubtedly have prior rights to the use of these waters.

Now the Rio Grande rises in Colorado and flows through New Mexico before it reaches the Mexican line, and the citizens of Ciudad Juarez have for several years past complained of exceptional scarcity of water, caused by the diversion of the head waters of the river in Colorado and the numerous irrigating canals that have in recent years been taken out, both in Colorado and New Mexico.

In 1888 the river was absolutely dry for over sixty days about August and September, and in 1889 it had no flow whatever from the 5th of August to the 20th of December. In 1894 the river was dry nearly all the summer after June 15, while this year the flow stopped on June 1.

It is not seriously contended that the water rights of Mexico are guaranteed by treaties, in which only rights of navigation are referred to, neither is it claimed the recent shortage of water is entirely due to the diversion of the upper stream. It must be admitted that the seasons referred to were exceptionally dry, with little snow in the mountains, and that similar drouths occurred, and are mentioned in history, previous to any irrigation works in Colorado. Nevertheless, when it is considered that since 1881 ditches have been taken out of the Rio Grande, and its tributaries in Colorado, representing a capacity of 21,278 cubic feet per second, and that reservoirs have been constructed with a capacity of 1,729,000,000 cubic feet, it is only reasonable to conclude that this consumption of water has materially contributed to, and doubtless aggravated, the recent scarcity of water at Ciudad Juarez.

The matter has already been the subject of diplomatic negotiations between the two governments, with the result that a joint commission is now engaged in investigating all the surrounding parts and of reporting to their respective governments.

In the meantime the Mexican government has formulated a claim against this government amounting to \$22,000,000 Mexican money for loss of crops during the last ten years, due to scarcity of water, but offers to waive these claims, provided the United States government will, at its

own expense, construct an international dam for the purpose of storing the surplus waters of the Rio Grande and of giving to Mexico half the water thus obtained.

If the United States government accedes to this proposition, it undoubtedly will be a solution to the whole difficulty.

A GOOD DAM SITE.

At a point some two miles above El Paso there is an admirable site for a dam, as shown in the accompanying photographs, one end of which would rest against the granite foothills on the American side, and the other end against those on the Mexican side of the Rio Grande. The dam of stones and cement would be about sixty feet high and some 500 feet in length, creating a lake fifteen miles long and seven miles wide, with a probable storage capacity of 4,000,000,000 cubic yards of water, the surface of which will be seventy feet above the streets of El Paso and Ciudad Juarez. It will irrigate about 200,000 acres of land, or say 100,000 on the American side and 100,000 on the Mexican side, and is estimated to give a water-power of about 6,000 horsepower to each side of the river.

The cost of building the dam is estimated at \$300,000, and \$700,000 for the removal of the road beds of the Santa Fé and Southern Pacific railways, while a further sum of probably \$500,000 will be required to pay for the land which will be submerged by the reservoir. The total cost may be put down roughly at one and a half million dollars.

The 200,000 acres which could be irrigated from the proposed dam comprise some of the finest farm and fruit lands in the world, but not more than one-quarter is at present under cultivation. The valley is famous for the renowned Mission grape, of which large quantities are shipped every year.

It will be seen that the dam will not only place the citizens of Mexico in a better position than they have ever hitherto enjoyed, for it will give them both water power and an assured supply of irrigating water at all seasons, but it will also confer an incalculable benefit on the American citizens of the El Paso valley.

*Since the above was written, the capital has been subscribed in London for building a dam in the river, which will bring under ditch the 45,000 acres of land which would be submerged by the international dam. Under these circumstances this land could hardly be condemned for less than \$2,000,000.

MORE PRACTICAL IRRIGATION IN KANSAS.

BY I. N. PEPPER.

ROOKS county is one of the places in Kansas that is blessed with a fair average rainfall, the amount generally ranging from twenty to thirty inches annually, the trouble being that there is frequently no rain when it is needed the most, and possibly plenty of it when it is not wanted. In addition, there are a number of years when there is a general deficiency.

The county lies just west of the center of the State and thirty miles south of the Nebraska state line. It was organized in 1872 and now has 10,000 population, over 100 schools, and is crossed by two railroads. The climate is as good as that of any place in the country. The soil is a dark sandy loam and produces first-class crops. Grass covers the entire county where not in cultivation, affording good pasture all the year round. Hay can be had almost for the cutting, thus making it a good section for stock and dairymen. Water is pure and plentiful in streams, and springs and wells are numerous.

The first settlers as a rule were grain growers, breaking up the native sod and cultivating about 200,000 acres of this vast meadow. With thirty inches of rainfall the crops were good, but with only twenty inches they were failures and those who had no cattle left the county. After several more attempts at dry farming, those that remained began to cast about for some method of supplying the small amount of moisture lacking, and of saving the surplus rainfall which they did get occasionally.

Many plans and suggestions were offered, but the only practical solution was irrigation supplemented by subsoiling. Investigations have demonstrated that there is a sufficiency of water if it is conserved and utilized. Wells are being bored, wind mills and pumps erected, water courses dammed, streams diverted by ditches and every means to impound the water and hold it for a time of need, resorted to.

The results have been gratifying in the extreme, and doubts concerning the arti-

ficial application of water removed from the minds of the most skeptical. Their only question now is, "How can we irrigate?"

There are two irrigation canals in Rooks county, owned respectively by the Bow Creek Irrigation Company and the Stockton Irrigation & Power Company. The Bow creek ditch was the first to be built. It is seven and one-half miles long, has a capacity of thirty-five second feet of water and covers about 1,000 acres of land. The Stockton ditch is three miles long, with a capacity of 100 second feet, and waters about 800 acres. It can be considerably extended.

In addition to the two enterprises mentioned above, there are a number of small individual irrigation plants.

Last year was the first in active operation of the Bow creek system, and the crop yields were astonishing.

Fifty acres of potatoes produced 10,000 bushels; onions yielded 600 bushels per acre of fine quality; cabbage four to six tons per acre; turnips 100 bushels on eight square rods, or at the rate of 2,000 bushels an acre. For oats, the land was irrigated in November, 1894, and seed sown in March, 1895; the yield was sixty-five bushels per acre, weighing forty pounds per bushel. In the same field and under the same conditions, except the irrigation, the oats yielded seven bushels an acre; corn, irrigated once, forty to fifty bushels an acre; the corn not irrigated was a failure.

On four acres under the Bow creek ditch, F. Near raised 1,100 bushels of best grade potatoes, with an actual expenditure of only \$7.00 for labor up to the time of digging.

An accident was the means of benefiting A. Jones. On July 19, 1894, the water broke through the bank of the ditch and flooded an acre of corn. On July 26 there was a hot wind, but it in no way affected or injured the acre that was accidentally flooded.

J. K. Wendover raised good corn with one watering, and first-class potatoes.

Cooper Bros., under the Stockton ditch,

are now cutting alfalfa seeded last June, and it is an extra fine and heavy yield.

The pumping plant of F. Shults irrigates twenty-two acres. His onions yielded 600 bushels an acre.

P. J. Griebel irrigates five acres, has a good garden and raises fine fruit.

Chas. Marten has five acres in a bearing orchard, mostly apples, irrigated by a pump.

Many farmers raise crops worth from \$50 to \$100 on an acre of irrigated land, and I know of some who have produced \$800 worth of cabbage on one acre.

FIFTY ACRE CABBAGE FIELD UNDER THE IRRIGATION DITCHES OF THE BOW CREEK SYSTEM.

THE ART OF IRRIGATION.

CHAPTER XIV. THE GREAT FLOODING SYSTEM OF THE SAN JOAQUIN VALLEY—Continued.

By T. S. VAN DYKE.

THE large checks described in the last chapter are almost always fed from the side and not from one end. They are generally so long that if fed from one end the water would have too long a run to reach the other end. It would also have less room in which to spread, and the large head needed to cover so much ground below would cut the soil too much, unless it could spread out. In case you want to cut the check in more than one place to get the water quickly out of it, which you generally should do, you cannot empty it so well from the end as from the side.

When made with the plow, as described, there will be a low swale adjoining the bank which will hold water too long, unless the bank is cut all the way down. Some things at some times of the year will not be injured by this. Old alfalfa, in winter, seems to suffer little if any in this way. But young alfalfa or grain would be damaged at once by it. Most

fruit trees would not be hurt by it in winter, whereas it would be ruin to some, and damage to the fruit on most anything but pears to have them in such a swale in the summer or spring. And when the sun is hot, old alfalfa and grain old enough to cut for hay would quickly show a material loss.

On the reclaimed swamp land mentioned in the last chapter all the irrigation of alfalfa and grain is in the winter, and even that of corn is practically so, it being irrigated not more than twice and often only once after coming up. Remember the average rainfall here is about four inches, or practically nothing in assisting the summer growth. But this soil is a mixture of tule roots, rushes and reeds for many feet deep, with water at an average of about eight feet, and rarely over ten feet below, the year round. The capillary attraction of this soil is enough to draw water more than half way to the top. It is very re-

VIEW OF AMERICAN SIDE OF THE SITE OF THE PROPOSED INTERNATIONAL DAM.

VIEW OF MEXICAN SIDE SHOWING RAILROAD TRACKS THAT WILL BE REMOVED.

THE GOULBURN WEIR, VICTORIA, AUSTRALIA.

THE LAANECOORIE WEIR, VICTORIA, AUSTRALIA

WASTE WEIR AT HEADGATE OF BOW CREEK IRRIGATION SYSTEM, ROOKS CO., KAN

tentive of moisture, so that if wet thoroughly in winter it will, by the aid of the rising moisture from the bottom, hold water enough in the top to mature such crops as grain that ripen very early in the spring, and it will come very near ripening even corn that runs far into the summer. Alfalfa, whose roots quickly go down to this permanent moisture, only needs a good stimulus of water in the top soil to start it more quickly, after the cold nights of midwinter have checked its growth.

GRAIN.

On this ground grain is sown *dry*. It is then plowed in, or rather scratched in, for there is no apparent advantage in deep plowing on this particular soil, as it is all loose enough except the crust, which will be formed on any fertile soil by excess of water. It is then irrigated so as to fill the top soil with enough water to sprout and carry it until ripe, in connection with the winter rains, of which there are always some of value, even in the driest times; one-third of an acre foot of water put in the ground will do this, for there is no loss of moisture downward, the entire subsoil being saturated instead of dry. If you will note how quickly a piece of dry, unplowed ground saps the moisture for several feet from a freshly irrigated piece beside it, you will understand how, with a dry subsoil, more moisture (not water only) will be lost downward than is lost upward by evaporation. But if there is no loss of this kind, grain well started with the top soil filled with water matures before the summer heat has its effect in drying out the top soil. Very heavy crops are raised in this way on this ground.

On the upland, where it is many feet to water, and where the subsoil for yards is as dry as the top soil, unless soaked from the ditches, all flooding is postponed until the grain is so large that it cannot be easily injured. The different quality of the soil is the principal cause of this. It is a fine granite wash, containing enough fine material to make a tough paste without enough humus to prevent its formation. On the swamp land there is so much vegetable matter mixed with the fine granite flour that it cannot make as hard a paste. To flood this upland after the grain is planted and before it has started would be to kill half or more of it at once. Dependence is therefore placed on the slow, gentle

rains, which do not beat down and puddle the ground. If the ground were thoroughly irrigated before plowing it would retain moisture enough to insure the starting of the crop in fine shape, but for grain at present prices this is considered too expensive, even when the farmer does his own work with his own teams. He would rather put in a larger area and gamble on a good rainfall, and from his standpoint of large farming it is hard to say he is not right. Therefore he plows his ground dry—that is, without irrigating. It may or may not be moist from the first rain, and generally is as dry as powder when plowed. Then it is checked for future irrigation if there are no permanent checks on the tract. Many of these checks are temporary only, especially where one is working rented land, as many do. Then the seed is sown for the rains to sprout and carry up to the point where it will stand flooding. This flooding is postponed as long as there is no danger of the crop suffering, and often it receives no water until headed out and even in the milk, while it is rarely irrigated until in the boot, unless in winters very short of rain. A second irrigation is rarely needed, but can be given if required. The water is applied sparingly and not left on the ground, even as long as for alfalfa. Even when quite old, grain of all kinds will quickly scald if the sun is hot, and great care must be used. While a delicate operation, large crops can be raised by irrigation with certainty and success, and tens of thousands of acres are thus raised here every year. Corn, and all summer crops like Egyptian corn and similar things, are raised in large quantities under the same system, though the yield to the acre is not what it would be if less water and more plow were used. But there is certainly a limit on fine work, and where land and water are so plenty and cheap it no doubt pays to work a larger area with a lower yield.

None of the land of Lux & Miller is yet for sale, but that of the Kern County Land Company is for sale for much less than any one person or ordinary aggregation of persons could ever put on the water from any source—from forty to sixty dollars an acre for as good land as the sun shines upon, with an annual payment of a dollar and a half a year on the greater part, running, under some of the canals, to two and a half. The water right is a cubic foot a

second to 160 acres, or about an inch to three acres, or nearly five acre feet. Several thousand acres have been sold and settled, and the work of the settlers is very instructive as showing what human nature will do when it has a good chance. They have almost to a man selected good land. There their wisdom generally stops. There are a few places from which a stranger might find something to imitate, but they are rare.

TOO MUCH WATER.

The Land Company, desiring to accommodate all its customers, and having all the time an excess of water, has put no restrictions upon consumers. The allowance of a cubic foot to a quarter section is already too great for anything but alfalfa, and not really needed even for that, but the rule has been to let all have all they want and in heads of any size they want. The result of this mistaken kindness can be seen all over, in damaged orchards, and in the few places where there is any hard pan or stratum of fine material underlying top soil, alkali is on the top soil to a ruinous extent. Soil and climate, and all conditions, show that as fine fruit can be grown here as in any part of California, which means in the world. Many places where some care has been used prove that it is so, the yield and quality both being beyond criticism. But many more show suffering trees that cannot bear good fruit, and that before long will bear little or nothing, and all because they have plenty of water. Every one floods for everything. Where the soil will carry small streams, and where they would be cheaper, more healthful, and in every way better, you see none of them and no attempt to do anything but flood. Imitating the work of the great farms, they make the checks too deep, put more water in them than is needed and keep it there too long.

The only cultivation is scratching the head to see how work with the plow and cultivator can be dodged. The effort has been very successful. I hate to say there is not a well cultivated orchard in the county. Therefore I will not say so, but that is my only reason. Even the flowers around the house are planted in checks of all shapes and sizes that are never broken, the ground being as hard as the floor of a brick yard. There are some orange trees near Bakersfield that are good enough to

show that a fine orange could be grown there. But no one seems to know that they are treated in the exact method in vogue twenty years before, two hundred miles south of them, and that never failed to produce a dry, insipid, sour, spongy, thick-skinned orange—to wit, incessant flooding with no cultivation. A gentleman who has been there over twenty years, told me that scores of men had bankrupted themselves and had to leave in three years, by the excessive use of water. Some do it because they think they are getting ahead of the company, although it is by its favor that they are able to do so. Others do it because they imitate these others. Some do it because they think water cheaper than work, a principle that is sometimes a very good slave but always a very bad master. Still others do it because they think turning on water is all there is of farming by irrigation. Some do it because they don't think at all, and some because, having the water turned on, it is too much like work to go to the gate to shut it off, California being full of people who came here to play and not to work.

But wherever the water has been used with any care you may see prosperity at once, in spite of the want of cultivation. Cultivation would make it still better but even without it it is plain that flooding pays. Good orchards and fine alfalfa patches may be seen in all directions, plenty enough to prove that intelligent handling of the water is all that is needed to make this the largest garden of California. The misuse of the water has proved that not more than one hundredth of one per cent of the land can be alkali and the way the alfalfa stand, the incessant tramping of the big bands of cattle, especially on the large ranches where they are never taken off of it, shows a vitality and toughness that in many other places it does not have.

FARTHER NORTH IN THE VALLEY.

Going farther north on the San Joaquin we soon reach the fertile fields of Tulare county. Here, even on the larger farms, we find the checks like those of the smaller places in Kern county, very much smaller and more shallow than those of the immense places above described. Most of them are square or rectangular, though many of them are conformed some-

what to the contour of the land. But there has been no such systematic laying out of the land as I have described. Many of the checks are not over five acres, running up to twenty and even forty acres, while on the ten and five acre tracts they run down to a quarter of an acre or even half of that. Most of them are made with the plow and scraper and on some quite level ground they are apparently made with the plow alone. Fifteen and eighteen inches are about the maximum heights, with many not over a foot. All are made broad at the bottom and almost all are permanent and can be driven over with machinery of any kind.

Gates from one check to another are here very rare and the main reliance is on cutting the check. But in many cases they do not feed one another and the checks are arranged in lines along laterals. In many cases the only waste ditches are natural depressions which retain much of the water to the joy of the mosquito. The average depth of water in the checks is less than is too often used in Kern county, and seldom exceeds six inches. The land here is extremely rich for many leagues and prosperous farms of alfalfa and general crops, with fruit farms of all deciduous fruits are about one. The never-failing and beautiful Kaweah pours every year, across the land, a bountiful supply of water and what was once a vast park of immense oaks is now in long lines of farms, with only a little park of the ancient oaks about the house or out in the pasture, to shade the thousands of cattle from the heat of a summer's noon. It is a lovely land to look upon, but here too the fatal gift of plenty of water has wrought ruin on many an acre of the deep rich mould of the old park and undone many a two-legged hog who thought he was getting ahead of his neighbors or cheating the water company.

ALKALI.

Thousands of acres are now useless from alkali on the surface, where it is evident from the surroundings and the character of the subsoil in adjoining cuts that there was no excuse for it. Most all of it can be reclaimed for there is plenty of drainage, but even such temporary ruin is shameful. It is but a few feet to good sheet water under the greater part of the land, with no hard pan of consequence be-

low the top soil. There is only a sheet of finer material over the greater part of it two or three feet below the top. With water so near the surface and the rainfall much greater than in Kern county there is no need of using any more water than is used south of the Tehachipi mountains where the finest work of the world is done.

On the greater part, furrows could be used as well as elsewhere, and the water now in the ditches could do twice or thrice the work it now performs. Yet everywhere you see where fields have been turned into swamps by allowing the water to run long after it should have been shut off, orchards with the top soil condensed to a cement by too deep, as well as too long standing water, others where the waste has been allowed to stand in the last checks because there was no waste ditch or because it was clogged up and the owner was too lazy to clean it, still others where the soil looks as if it was wet every week and never had a chance to dry. As I remarked about the other place, I don't like to say there is no attempt at good cultivation, therefore I won't.

But in spite of all this there are so many places that show unmistakable success in making, not only a living but also some money that, in spite of the gross waste of grand opportunities this settlement must be considered a great triumph of irrigation. There is no place in the lands depending on the rainfall direct that can show any such wealth to so few acres and certainly none that can show so many farmers out of debt and with a comfortable balance in bank. There are unmistakable signs of prosperity, in spite of the hard times, that he who runs may read, and nowhere are they more positively written all over a section than over a great majority of the alfalfa fields and orchards here. On the alfalfa farms and especially those mixed with a little fruit and vegetables, with corn and pumpkins, Egyptian corn and some other things, you can see at a glance that certain living that once made the American farmer the most independent of mortals, as he was then called, and the neglect of which has reduced too many to the most dependent. In the fat cattle and the baled hay, in the corn in the bin, in the hens cackling around the straw stack, and the turkeys strutting about the road, you see a surplus for pin money, while the big udders on the cows and the great

numbers of fat hogs in the fields show that they do not live on Chicago canned beef or flavor their coffee from tin cows. It is the farming that the American farmer must drift back to. He must quit listening to those who tell him that any system of finance or any abundance of money will enable him to buy everything he can raise himself, hire work that he can do himself, and enjoy, simply because he is an American farmer of the nineteenth century, luxuries that the richest dirt never yet has justified in any other country. The irrigating farmer can restore farming to its ancient respectability and he is probably the only one that can. It must be so restored, or there is little increase of prosperity in store for the great United States. The farm must be made attractive to the boys, and the irrigated farm now comes too, near being the only one where they can see that they are not working for nothing. On the irrigated farm the girls, too, can see something beside work ahead, and the old folks feel while pulling the sled uphill that there is a chance for them to ride down before they die.

Following the winding Kaweah up the foothills and into the great canyon, down which it foams from the lofty Sierra Nevada, I found many places where every variety of irrigation was attempted. Tulare county too has its "orange belt," and its a hard county in California that has not. This belt, though not over large, is unmistakably good but suffering from bad irrigation which the orange is sure to do. The looks of the trees told the tale well enough. Many of the oranges and some of the lemons were indicating foot rot on ground that was naturally well drained, an almost unfailing sign of over-irrigation. One man was making a vigorous attempt to irrigate with small furrows. The soil was plainly fine enough in texture to enable him to do it, but the ground was sloping about twenty-seven different ways in wavy lines, and the water had evidently become so tired trying to get somewhere that it had finally given up the job and settled down permanently in the middle. By the time he finds he wants the ground graded to an even slope on every face on which the water is to run, the orchard will be too old to change and then the swearing period will fairly begin.

I found some people irrigating by planting along the ditch in the old Indian way

and others letting the water wallow around over the ground to suit itself and planting on the dry bumps it had left, but nowhere a decently irrigated place, although there was abundance of fine soil and an over-abundance of the finest water. But the place at which I spent the night, well up in the canyon, skimmed the cream of the whole entertainment. The owner was a rich old settler with money out at interest in all directions. He had a ditch carrying about four feet of water, or two hundred inches. This ran through his store making, at one side of the door, a drop of some five feet upon an overshot wheel which turned a large fanning wheel in the center near the ceiling. In the breeze of this, the old gentlemen sat and drank beer and smoked away the summer days while waiting for customers. Passing on some hundred yards or so, the water spread upon a gravelly flat of five or six acres. This was filled with alfalfa and fruit trees. There were peaches, prunes, pears, apples, silver prunes and nectarines all ripe, and we were badly in need of fruit, especially on the return from a fishing trip near Mt. Whitney where it is a little cool for fruit. The alfalfa and fruit trees were all in a huddle together and the evident design was to get both irrigated at one stroke to economize labor. The labor of shutting off the water was evidently objectionable and therefore never done as far as appearances went. The whole of this enormous head was running upon this five or six acres all the time we were there, and coming and going, and there was good reason to believe it had been running all the season. There was a fair stand of alfalfa on it in spite of the cows nibbling, but the fruit was everywhere sour, insipid, and *small*. It was about the worst I have seen in California and that is saying a good deal, for while California can raise the best fruit in the world with good care, it never makes a failure of raising the most abominable on earth when it tries.

Now the point I wish to emphasize is this—this was a wash of coarse gravel standing on a slope so great that in spite of the great head of water it all drained away underneath, the top showing no sign of swampiness anywhere. Here, then, was the choicest of conditions for growing the best fruit on earth, climate and all being as perfect as the drainage. The alfalfa

did quite well because it will always do well on well drained soils, even if pretty poor, for to some extent the theory that it makes its own fertilizer seems true. But the food the trees demanded was leached away by the constant run of water, making trees and fruit both small although the trees were lightly loaded; while the trees, sickened by having the roots all the time too wet in spite of the drainage, could not produce good fruit even on rich soil.

As I remarked in the beginning of this work, bad irrigation is generally far ahead of no irrigation, even in those countries where so much can be raised on the rainfall as to make people feel insulted when you advise them to irrigate. Yet nothing

is more foolish than to follow the methods of certain sections simply because they are succeeding. You may learn much in the San Joaquin valley about flooding especially on the large scale. But when you have seen it all, spend a few days among the small farmers of Orange county if you want to learn how to make a good living and some money over, out of a small piece of land with, the smallest amount of discomfort, and do, it all by flooding. Yet there you can learn nothing much about furrow work for their land is generally too open for it and they should not attempt it. To see that, go to San Bernardino and Riverside counties, and the east half of Los Angeles county.

IRRIGATION AND SUBSOILING.

PRACTICAL METHODS IN VOGUE IN MONTANA.

BY S. M. EMERY, of BOZEMAN.*

THE conservation of moisture in the semi-arid States, is quite as important a problem as is that of securing the benefits of irrigation in States where this has not yet been practiced.

In the Gallatin valley, the acknowledged peer of all agricultural development in Montana, if not, indeed, of all sections of the mountain States, land is cheap and abundant, and the practice of summer fallowing is quite universally practiced.

There are large areas of bench lands above the water course level, on which crops are grown uniformly successfully by summer fallowing each alternate season, winter grains being the common crop. In the valley proper it is the general custom to summer fallow every third year, alternating the two seasons to oats and barley, or wheat and barley, and occasionally to wheat and oats.

By this practice they are able to uniformly grow crops double and treble those in States where water is not used.

There are well-grounded objections to this style of farming, especially where irrigation can be practiced. It is an expensive way to farm; the land usually becomes weed-sown, and scientists teach that it is injurious to soil to turn it up to the summer storms and sunshine unprotected by verdure, and taxes and, too often, interest are being assessed, whether the land

is producing or not. By personal inquiry it was learned that the average of fallowed land in the Gallatin valley in 1895 was more than 100 acres per farm. This affects quite seriously the question of additional water, when the time comes, as it most certainly will, for yearly cropping of all Montana farm lands. Had the entire area of land under plow in this valley been sown to grain crops in 1895, there would have been many crops injured from lack of sufficient moisture.

DIVERSIFIED CROPS.

The Experiment Station Farm is being cropped, every foot of it, each year, and though there is a water right of 100 miners' inches to 185 acres, it is ample for the farm requirements. Crops are diversified—alfalfa, clover, field peas, potatoes, mangels, carrots are favored crops. In grains wheat, oats, barley, flax and rye are leaders. By thus diversifying, the use of water may be protracted at each end of the grain irrigating season, the grasses and clovers being watered weeks ahead of the grain crops; again, fall irrigation has been practiced with the intent to store moisture against the day of need.

The writer has been strongly impressed with the importance of deep culture, and is now reaping a mis-benefit therefrom in a phenomenal crop of wild sunflowers on

*Director of the Experiment Station.

lands which for two years past have not ripened a sunflower seed. Evidently the seed have lain dormant in the soil for four or more years, deeply buried by an extra deep plowing in the fall of '93 and resurrected the present spring by a similar course.

Deep plowing, as ordinarily practiced, is not satisfactory where there is heavy clay subsoil; too much subsoil is exposed on the surface. This is doubly bad where water is applied to grain crops as the clay will dissolve, puddle the surface of the ground and bake so hard that a second irrigation brings little relief to the crops.

BENEFITS OF SUBSOILING.

In 1895, ten acres in which potatoes were to be planted were subsoiled to a depth of eleven inches. The single subsoil plow was used, drawn by three horses, and following a turning plow also drawn by three horses. Considering that two men and six horses were employed, and that one and a half acres per day was a daily average, it was expensive work. In irrigating it was found that much more water was required to submerge the soil than on lands not *subsoiled*. This piece of land is now sown to barley, and gives promise of being an extraordinary crop. (The tract has never been manured to the best of our information.) Upon receiving a prospectus of the Secretary plow, made by the John Deere Company, one was ordered and has been used upon fifteen acres of spring plowing.

This plow is a combination of the disk and subsoil plow, and, by a single operation, the ground is subsoiled each two inches in ten, and the top soil completely pulverized by the action of the disk plow. Its strongest point is that the wedge principle involved in all turning plows is applied only to the two-inch strip under the subsoiler, the disk working above the subsoiler, and cutting and partially turning ten inches, while the subsoiler works two inches in width.

The application of water to the soil thus treated this spring will be watched with the keenest interest and it is a foregone conclusion that it will absorb at least double the amount of water that soil fitted with the old-style turn plow does. To get the full effects of such moisture deposition, it should be coupled with a high state of preparation of soil prior to seeding, so complete as to pulverize all clods and lumps; subsequent to seeding,

the ground should be rolled to compact the surface and hasten germination, and prior to the appearance of the young blades of grain the ground should be gone over with a fine tooth harrow each way, so as to supply a dust blanket to prevent undue evaporation of moisture.

It is of the utmost importance that water be used at the earliest possible moment after grain is well up. There is then an abundance of water and, unless storage reservoir facilities are provided, the farmer must daily see water run to waste, the use of which in a very brief time would mean a difference between failure and success.

Upon this same subsoiled land, well-rotted barnyard manure is now being applied upon growing grain crops with the Kemp & Burpee manure spreader. This gives an even distribution of manure, no lumps being thrown out, all such being well pulverized by the revolving cylinder, armed with sharp pointed teeth which tear all lumps to pieces.

This spreader was used in 1895, until the grain began to joint, and though it seemed as if the battered and bruised grain would never recover from the severe treatment inflicted in driving the wagon over the fields; yet, in three days time after the application of the water, one could not tell where the spreader had gone, save by the deep rich color and the rank growth of the grain.

Subsoiling, thorough preparation of the soil before and after seeding, a diversity of crops, the use of clovers and root crops, and top dressing of grain fields must all be practiced by him who expects to make the most of a limited water supply.

To one unaccustomed to the use of water it may seem paradoxical to urge a course that will require more water to saturate the soil. It is, however, true "the more haste the less speed" in this case. One should endeavor to make a crop with one irrigation, as it is exceedingly difficult to make up to crops by a second irrigation that which they have failed to receive in the first use of water. In mountain regions the second or third irrigation has a tendency to unduly prolong the growth of grain and to expose it to the ill effects of early frosts. Hence the important part played by deep culture in the conservation of moisture.

WATER SUPPLIES FOR IRRIGATION.

CHAPTER VI. STORAGE RESERVOIRS, EVAPORATION AND PERCOLATION.

By F. C. FINKLE, C. E.



UCH surveys and examinations as will give a complete description of the character and condition of the watershed should be made. The points to be noted are the slope and pitch of the surface at dif-

ferent places, the character of the surface formation, the range of elevations and the amount and class of vegetation. All observations of this character furnish data from which the value and capacity of a watershed can be estimated.

The ability of a watershed to furnish water for storage depends upon the matters which we have already discussed, *i. e.*, the area and character of the watershed and the amount of annual precipitation thereon. The old school of hydraulic engineers were wont to assume that the discharge of water from a watershed, available for storage, was equal to one-half of the total annual rainfall on the watershed. While it is true that this was the general assumption, still there were many who depended more on their own judgment as applied to each individual case. This latter method is not entirely unsatisfactory as the judgment of one well versed in hydrology, when he is acquainted with the geological structure, extent and physical characteristics of a watershed, is usually able to grasp its capacity for yielding an available water supply, by deciding what proportion of the rainfall will be discharged and what proportion will be lost in various ways. But neither of these methods are satisfactory for making close and accurate estimates, and since statistics have been collected from observations made and recorded by government bureaus and hydraulic engineers, the matter has been reduced to more of a science.

The observations from all points do not

exactly correspond, which makes it difficult to produce a formula which will give results for all places. It appears that results obtained from localities where the distribution of the rainfall is uniform throughout the year, are somewhat different from those obtained in regions where the year is divided into a rainy and a rainless season.

Our investigations being in the interests of irrigation, we will devote ourselves to constructing a formula applicable to regions with the year divided into a wet and a dry season.

FORMULA FOR STORAGE SUPPLY.

By plotting such results as have been collected from observations made in irrigated localities or localities requiring irrigation, where the distribution of the annual rainfall is somewhat irregular, the resultant has been found to follow very closely the following formula:

$Q = A \frac{p}{100} \times c \times f$, in which

Q = the number of cubic feet of water discharged during the year.

A = area of watershed in square feet.

p = percentage due to character of watershed.

c = a variable factor depending on the annual depth of rainfall.

f = the depth of annual rainfall in feet.

The percentage due to natural characteristics of the watershed and represented in the formula by the factor p varies from .30 to .85.

The mean values are as follows, and for cases not corresponding exactly to the descriptions given, values intermediate to those given can be assigned in actual practice:

For steep, rocky hills and mountains from .75 to .85.

For heavily timbered hills or mountains and moist brushy and swampy lands from .65 to .75.

For rolling grassy brush or timber land from .50 to .65.

For tolerably flat or gently sloping alluvial plains, with little grass and brush from .40 to .50.

For flat or gently sloping cultivated lands from .30 to .40.

The variable factor c has the following values:

For an annual rainfall of 40 inches or upwards, $\frac{2}{3}$; for 30 inches, $\frac{3}{4}$; for 20 inches, $\frac{1}{2}$; for 10 inches, $\frac{1}{3}$; for less than 10 inches, $\frac{1}{4}$.

The values of c intermediate to those given can be found by simple proportion, and all values when used in the formula should be written in per cent decimals, which are better adapted to logarithmic computation.

From the recorded observations and the formula deduced therefrom, it is patent that a large portion of the water falling from the clouds does not flow off on the surface of the ground. This water becomes lost in various ways, or in other words goes where it is not visible in channels on the surface, nor can it be collected to fill storage reservoirs. A portion of it is evaporated, and returns to the air to again fall as rain; a portion is consumed by the growth of vegetation, and the remainder, which is by far the greatest portion, sinks into the ground and goes to constitute underflow of streams, subsoil water, spring water, and the water contained in artesian strata.

When it is possible to do so it is always advisable to measure the daily discharge of water from a watershed, in addition to making a survey of it and gaugings of the rainfall. By doing this it is possible to determine accurately what is the actual quantity of water running off on the surface without the inaccuracies and uncertainties which are always involved in theoretical formula and calculations. Usually the cost of measuring discharges from streams is quite great in comparison with the cost of gauging the rainfall, and for this reason it can not be carried on so easily nor for any great length of time, unless in exceptional cases. In all cases, where it is possible to do so, the discharge should be measured and the rainfall gauged as well for at least one year. In this way the variable factors in the formula can be given fixed values applicable to the watershed in question, and the formula

can be so expressed as to eliminate all elements of uncertainty, so that perfect results for the watershed in question can be obtained for subsequent years, although observations of the rainfall alone are made.

EVAPORATION AND PERCOLATION IN STORAGE RESERVOIRS.

All the water accumulated in storage reservoirs can not be applied to useful purposes. There are certain losses causing shrinkage in the volume of water after it is impounded, which must be deducted before the amount available for use can be ascertained. The two principal means by which water is abstracted from a storage reservoir are evaporation and percolation. The former of these can, in ordinary cases within the region where irrigation is practiced, be considered to equal the amount of rainfall on the surface of the reservoir. At all events it is perfectly safe to make this assumption, as the rainfall on the surface of the reservoir is more likely to exceed the evaporation than not to equal it. Of course, when evaporation is accounted for in this way, the area of the impounding basin must be subtracted from the total tributary watershed above the dam site, in making the surveys and estimates of available watershed for filling the reservoir.

The amount of percolation is a more difficult matter to arrive at, as the soil comprising the basins of storage reservoirs may be of any conceivable nature. Very often ledges or veins in the sides of the basin may convey a considerable amount of the water impounded away to points below the dam. In cases of this kind, where the loss of water is great, it can readily be noticed and remedied. If the water entering the reservoir is heavily charged with silt and sediment, the difficulty may remedy itself. The most dangerous species of percolation, however, is that which finds its way into entirely underground channels and can not be noticed except for its effect in diminishing the water in the reservoir, as its reappearance takes place so far away that it can not be easily detected in this way. The only way of determining its amount is by accurately measuring the water drawn from the reservoir, while observing the exact quantity disappearing from the reservoir during the same time, as well as the quantity entering it if any.

In faultily constructed dams there is sometimes a loss by percolation through the dam, but in works properly planned and carried out, the loss on this account, if any at all, should be so small as to be of no practical consequence.

SUMMARY OF NECESSARY SURVEYS.

Considerable reference has already been made to surveys necessary in the investigations relating to storage reservoirs. A summary or recapitulation on this point may not be amiss, as the subject is one of great importance. The following are the principal details, which should in all cases be covered by such surveys: The area of the reservoir site or storage basin should be traversed with a line containing no greater error in closing than is usually admitted in making surveys of land boundaries.

Contour lines should be run throughout the reservoir site at elevations of not more than ten feet apart.

The area of the watershed should be determined by a survey such as the necessities of the case may require. As has already been stated, the location of the principal points on the boundaries of the watershed is sometimes sufficient, while at other times the exigencies of the case may require a traverse survey similar to that recommended for obtaining the area of the reservoir site. The topography of the watershed and the length and courses of its main drainage channels should be de-

termined by appropriate surveys. Cross-sections of the canyon or outlet of the valley at the point selected for the dam site at distances of not more than ten feet apart, for a width of not less than an eighth of a mile.

Borings to bedrock, or other material, suitable for a dam foundation, should be made across the canyon at the dam site at intervals of about twenty-five feet.

Surveys should be made to determine in what manner the water can be drained from the foundation of the dam. If the draining can be done by cuts or tunnels the length of these should be measured, and the material through which they will be constructed should be noted. If the draining must be by means of pumps, the height to which the water will be pumped, as well as the quantity of water to be raised, should be determined.

The gauging of the rainfall and discharges from the watershed already referred to should, of course, be made with great care, and such other observations in regard to evaporation, percolation, etc., as are deemed of value should also be made.

When all of these data have been collected by reliable surveys, the calculations necessary to determine the value of a reservoir site and the cost of improving it become an easy matter, and an engineer can proceed to make his report with certainty and confidence.

ADULTERATION OF FOOD PRODUCTS.

BY W. C. FITZSIMMONS.

THE average citizen has little conception of the extent to which much of our daily food is adulterated with foreign substances, many of which are injurious to health. A still greater portion of the adulterants used are often, if not always, distasteful or disgusting. A theory of some scientists is that the ultimate atoms of matter are all of the same substance, and that material things as we find them, so varied and diverse in characteristics, are merely the results of an infinite diversity of combinations among the ultimate atoms and molecules of matter. It is asserted that a palatable article of syrup may be

made of rags; and while the ultimate analysis of the two might reveal the same primal elements in their composition, the knowledge of the fact would scarcely render such syrup especially appetizing.

In order to give readers some conception of the extent to which adulteration of substances daily consumed by all is practiced, citations from a report emanating from the Department of Agriculture will prove of value. It was found by a series of careful and prolonged investigations covering the range of nearly all food products, including potatoes, that the amount of adulteration is at least 15 per cent. of which no less

than 2 per cent. is of a character injurious to health. In this report the cost of food, drink and drugs annually used by the people of the United States was placed at \$6,780,000,000, and that we pay for the frauds and cheats used in our annual food supplies \$1,014,000,000. But this is not the worst of it. For the substances used which are clearly injurious to health, we pay the enormous sum of \$136,200,000. The lives of many and the health of millions are thus sacrificed and impaired at enormous cost without any compensating considerations whatever, except that of putting blood money into the tills of ignorant or unscrupulous dealers. In view of the enormous extent to which food adulteration is now known to be carried on throughout the country, the people cannot too soon awaken to the dangers that beset them on every hand. Whatever stringent legislation may do to check this growing evil should be done without delay, and such precautions taken by the strong arm of authority as will protect the average consumer from the criminal rapacity of those who thrive by the nefarious business of adulterating food products.

In this connection, Special Agent Wedderburn of the Department investigation says: "As there exists no more serious or exhaustive drain upon the resources of the people than the adulteration of their food and drug products, the federal government should enact a law to prevent the transportation of misbranded, poisonous or deleterious food and drugs from one State or Territory into another, not interfering with the police powers of the State."

No doubt such a law, strictly enforced, would tend greatly to lessen the consumption of adulterated food. Yet it must be remembered that there are great numbers of people who daily consume food known to be adulterated by substances which should be and probably are known to them to be deleterious. Such people must be protected against themselves by prohibiting, so far as is possible, the manufacture and sale of foods produced from unsuitable materials, as well as those adulterated with needless or unsavory substances.

Professor Berthelot, the renowned French chemist, believes that ultimately, nearly all human foods will be made artificially from materials drawn from the air and the earth. These will be synthetically combined in great factories and will re-

sult in pure foods, containing the proper proportions of each of the chemical ingredients of which we now find them composed. There is nothing revolting in this idea of the great chemist, for it is inspiring rather than otherwise the thought that the time may come when we shall derive our food supplies from first hand, and without the necessity of their having passed through the filthy workshop of nature as we see it. While we may consume something of the contents of the city sewers in the potatoes or oranges used on our breakfast tables, we have no desire to dwell upon the too intimate relations between cause and effect in this connection, or to scrutinize too carefully the natural processes by which the ultimate combination was reached. We must merely accept the general fact that the molecule of nitrogen which found its way from the sewer to the pulp of the orange, reaches us practically uncontaminated.

But while we are waiting for a realization of the iridescent dream of Berthelot, we may properly give attention to some of the practices of our fellow citizens who are less scrupulous about the sources whence they draw the material for the so-called food products which they place upon the markets. It will be remembered that Senator Manderson, of Nebraska, was recently reported to have made a stout defence of the manufacture of what is vulgarly called "bull butter." * He is reported to have affirmed that his senatorial appetite was more appreciative of the value and toothsome-ness of oleomargarine than of the average dairy butter of Nebraska. Whether the report was a libel against the Senator, being incorrect, or whether, being correct, it was a gross libel against the dairymen and farmers of Nebraska, it is not material here to inquire. The main thing is that one of the honored lawmakers of a great State was reported to favor the substitution of a product, which may be and often is made from highly unsavory materials, for the genuine article of butter properly made in a cleanly manner from healthy sources.

Those who agree with Senator Manderson that oleomargarine is as good as genuine butter, may possibly modify their views on reading the following from one of the recent monthly magazines:

"Not the least interesting feature in New York is the value of the dead horse that

one sees daily fallen by the way in our gutters and on our pavements. What it ultimately will produce in commerce is between \$25 and \$30. There is not a part of the animal that has not mercantile uses. Out of the hide are wrought gloves, boots and shoes; the hair goes into cloths and mattresses; the bones into buttons; the flesh into oil fat, oleomargarine and butterine; the hoofs into glue; the intestines into delicate membranous pouches for drugs and medicines. And it can scarcely be an agreeable sensation to those of the Ameri-

can body politic who swear their gastronomical faith on a plate of buckwheat cakes ordered from the restaurant of the period, with a side partner of three strata of butterine alongside for concurrent consumption, should he stop to reflect that the fleshy part of a dead horse, seen perhaps a week previous lying on Broadway, was the basic property of the dressing applied to his provender."

*This was written shortly previous to passage of laws against filled cheese.

LEGISLATION RELATING TO IRRIGATION.

BY CLESSON S. KINNEY.

IN the case of Puttnam vs. Curtis et al., recently decided by the Court of Appeals of Colorado (43 Pac. Rep. 1056), it was held: The respective interests of different persons in the same irrigation ditch cannot be adjudicated in a proceeding under the general statute of Colorado, section 1766, authorizing proceedings to determine the priority of right of appropriation of water as between different ditches in the same water district.

ABANDONMENT OF RIGHTS.

It was also held in the case last above referred to, that the non-appearance of the owners of an interest in an irrigation ditch in a proceeding under section 1766 of the general statute of Colorado, to determine the priority of right of appropriation between it and other ditches in the same water district, does not show an abandonment by the owner of his interest.

RIPARIAN RIGHTS—RIGHT TO PUMP WATER FROM A STREAM.

In the State of California, both rights acquired by appropriation and rights of riparian owners are held to be valid. In the case of Charnock et al. vs. Higuerra et al., decided by the Supreme Court of that State, it was held that a riparian owner may pump water from a stream for irrigation purposes, provided that he takes no more than his proportionate share, the method of diversion being immaterial; and that the amount of water which a riparian owner may take for irrigation purposes is not limited to that necessary

for land to which the water may be led in ditches by force of gravity, but extends to the taking by pumps or otherwise, of water necessary to irrigate lands above the level of the stream.

SUBTERRANEAN WATERS.

In the case of Gould vs. Eaton et al., decided by the Supreme Court of California, on March 21, 1896 (44 Pac. Rep. 319), the court held that percolating waters belong absolutely to the owner of the soil, and that his title thereto is not affected by the fact that an impervious strata beneath, and on which the porous strata containing the water rests in close contact, diverts the course of percolation to and over adjoining land into a natural stream.

Mr. Justice Harrison, in rendering the opinion of the court in the above case, said:

"The rule is well established that the principles of law which govern the right to waters flowing upon the surface of the earth are inapplicable to waters which are beneath its surface and percolate through the soil. The water which is held by the soil is a portion of the soil itself, and belongs to the owner of the land, as fully as any other ingredient of the land. *Hanson vs. McCue*, 42 Cal., 303; *Railroad Co. vs. Dufour*, 95 Cal., 615; 30 Pac., 783. This rule is not changed by the character of the material through which the water percolates—whether it be loose sand or a more compact sandstone. So long as the water is in a condition of filtration or percolation, it is a part of the

soil, and subject to the sole dominion of the proprietor of the land in which it is found. The appellant does not dispute this proposition of law, but contends that it is inapplicable to the present case, inasmuch as it appears from the findings of fact herein that, by reason of the seam of clay which separated the strata of sandstone, and which is impervious to water, the waters which had, up to that point, been in a state of percolation through the sandstone ceased to be in percolation, and thereafter passed along the seam in the direction of the creek; that this constituted a defined stream of water beneath the surface, and is to be governed by the same laws as govern streams upon the surface of the earth. This conclusion, however, necessitates the inference of a fact from the findings which has not been made by the court, and which will have the effect to defeat the judgment which the court has rendered. The inference of one fact from others, unless such fact is a necessary conclusion from those others, must be made by the trial court; and, if the facts that it has found are such as might authorize different inferences therefrom, it will be assumed that the inference made by the trial court was one that will uphold, rather than defeat, its judgment. *Breeze vs. Brooks*, 97 Cal., 72; 31 Pac., 742.

The court has not found that there is any flow or stream of water at the seam of the stratum, nor do the findings which it has made authorize such a conclusion. As it must be assumed that the stratum of sandstone is uniformly porous, and extends close to the seam which limits it, it must follow that the water within that stratum is in a state of percolation until it is arrested by the seam, and is thereafter, by reason of gravitation, diverted toward the channel of the creek. The mere diversion of its direction does not, however, change its character from percolating water to a flowing stream. So long as it is within the sandstone, although the lower part of the stratum may be more highly charged with the water than the upper part, it merely percolates through the sandstone until it is freed at the outcropping of the stratum where it borders upon the stream. It is frequently the case that the course of percolating waters is in some definite direction, but the owner of the land in which they are found has the exclusive dominion over them, and does not violate the rights of another by appropriating them to his own use, even though the effect be to divert their course from adjacent lands, or to destroy the advantages therefrom previously enjoyed by an adjacent proprietor. The judgment is affirmed."

BEET SUGAR FACTORY IN NEW MEXICO.

(From the New York Mail and Express, May 9, 1896.)

THE beet sugar industry of the United States, though it has made rapid progress during the past few years, is still in its infancy; and this for the reason that the importance of the beet as a source of sugar has not been generally recognized in this country. It is a fact that three-fifths of the world's product of sugar is derived from the beet; and the very insignificant part which the United States as yet plays in this industry is shown by the further fact that it contributed but 30,000 tons to the world's production of 3,500,000 tons of beet sugar in 1895. The United States imports over 80 per cent of the sugar it consumes, and this in 1895 amounted to 1,587,000 tons, for which it sent abroad upward of \$100,000,000. Since this sugar

comes from countries which buy very little from the United States it has to be paid for mostly in gold. If the United States should produce all its own sugar, this annual demand for gold would be relieved by nearly as many dollars as twice our whole production of the yellow metal. That this annual drain will be rapidly reduced when it is learned that the sugar can be produced at home and yield handsome profits both to the grower of the beets and the manufacturer of the sugar, goes without saying; and it seems equally certain that one of the very important centers of development for the new industry will be the Pecos valley in South-eastern New Mexico.

The soil and climate of this valley are

wonderfully adapted to the cultivation of the sugar beet, which here attains a higher perfection, both as regards the percentage of saccharine matter and the yields per acre, than anywhere else in the United States or Europe. Sixteen per cent. sugar and twenty tons to the acre are average results secured throughout the valley, while 20 per cent sugar and thirty tons to the acre are by no means exceptional attainments by the Pecos valley farmer. Single beets have been analyzed yielding as high as 23.75 per cent. sugar. The significance of these results will be understood when it is learned that the average elsewhere in the United States and Europe does not exceed 13 per cent sugar and twelve to fourteen tons per acre. Moreover, from the practically winterless climate of the Pecos valley and the absence of destructive frosts, beets can remain in the ground throughout the winter without harm to their saccharine value. Instead, therefore, of being compelled, as elsewhere, to handle the season's crop in from sixty to eighty days, the Pecos valley factory can run at least 150 days, producing a proportionately greater amount of sugar and yielding a proportionately greater profit upon the capital invested. The Pecos valley, therefore, possesses very manifest advantages in the manufacture of beet sugar, and there appears ample basis for the belief that it will be the center of a very considerable development of this industry in the near future.

The factory now in course of erection in the Pecos valley is located at Eddy, New Mexico, in the center of the valley, and is only the seventh to be established in the United States, while in Europe there are about 1,450. It will have a capacity of 225 tons of beets per day, and will produce from 7,000,000 to 9,000,000 pounds of refined granulated sugar each season. The farmer and the factory will share in the profits of the business. At \$4 per ton, which is the price paid for beets delivered at any station on the Pecos

Valley Railway, the farmer should clear all the way from \$35 to \$75 per acre on his crop. Two thousand acres will be raised the present season in this valley, and it is not an unreasonable expectation that this acreage will be increased tenfold within the next three years.

The results achieved in the Pecos valley place it in the foremost rank of the world's greatest irrigation systems. An ample and unfailing supply of water for irrigation has been applied to a soil of marvelous depth and richness, and these are supplemented by a climate warm and sunny and eminently friendly to plant growth, with the result that the wonderful transformation from arid waste to verdure-clad field and garden is rapidly taking place. Of the 300,000 acres or more that will ultimately be reclaimed under this great system, 75,000 acres are already in the hands of settlers, fully one-half of which is under cultivation. Most of the grasses, grains, vegetables, berries and fruits of the temperate zone grow in utmost luxuriance in this garden spot, as do also the fruits of the temperate and semi-tropical climes, with the exception of the citrus. The range of products is remarkable; the apple and the semi-tropical grape alike attain highest perfection. Many of the most valuable forage plants, and especially alfalfa, yield enormously, making the raising and fattening of cattle, sheep and hogs a most profitable industry. In short, this fertile valley, with its magnificent water supply insuring unfailing crops, would seem to offer the largest opportunity to the farmer and horticulturist; while its climate, which is dry and warm and sunshiny, is not only delightful practically throughout the year, but is also notably healthful and health-restoring, curing or alleviating many chronic diseases, including consumption and nervous prostration. The Pecos valley is destined to become one of the noted health resort centers of the United States, ranking with Colorado and California, and surpassing these in some respects.



THE DIVERSIFIED FARM

In diversified farming by irrigation lies the salvation of agriculture

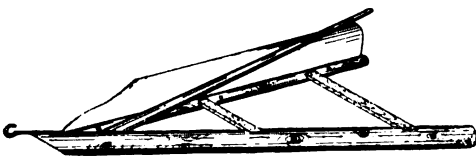
The Age wants to brighten the pages of its Diversified Farm department and with this purpose in view it requests its readers everywhere to send in photographs and pictures of fields, orchards and farm homes; prize-taking horses, cattle, sheep or hogs. Also sketches or plans for convenient and commodious barns, hen houses, corncribs, etc. Sketches of labor-saving devices, such as ditch cleaners and watering troughs. A good illustration of a windmill irrigation plant is always interesting. Will you help us improve the appearance of The Age?

A DITCH CLEANER.

BY JOEL SHOMAKER.

ONE of the most useful of home-made farm implements is a ditch cleaner made by a Utah man. It consists of the forks of a tree cut about ten feet long, on one side of which is a share of half a plow. The plow is heavily weighted and pulled through irrigation ditches, canals or creeks by horses. It throws out gravel and mud in a most wonderful manner. Two men with four horses can do the work of half a hundred ditch men with shovels. This man owns about six miles of ditch and can clean it out every spring quicker than co-operative ditches with thirty men are cleaned.

The ditcher is a funny-looking machine and one not knowing what it is used for would have to guess many times. A tree trunk about ten feet in length and one foot in diameter was cut so that a smaller limb would project at an angle equal to the figure V, making the back opening about three and one-half feet. The main trunk was hewn down smooth on the outer surface and the limb cut sloping from the top to the outside. Stanchions were set in both, so as to make cross braces. On the sloping side was tacked a flaring piece of sheet iron made much in the shape of a plow share. Weights were put on the front and on the cross pieces. A long pole, probably fifteen feet in length, extended from an iron band in the front, over the top and behind.



A DITCH CLEANER.

The pole is used to raise the front of the ditcher when necessary. A man swings his weight upon the back and thereby lifts the front or points from the mud. A big hook is bolted on the top to which, by a long chain, the double-trees are attached. In ordinary work two horses can pull the ditcher, but in most cases where the ditches are filled with mud and gravel two teams are necessary. To strengthen the plow and make it more substantial, braces of iron could be put in, extending from the center cross beam to either runner, as in a sleigh. The machine is primitive and a mere emergency makeshift, but contains the elementary principles for a fine ditcher.

In constructing new canals it has no equal, considering the expense of making. For cleaning drains the machine is of equal benefit as in clearing ditches. The eastern farmer needs such a cheap, handy implement as well as the western irrigator. There is no patent on the idea. Some six by eight good oak timbers will make a better ditcher than an old tree. Creeks that overflow can be cleaned by one of those machines so that a channel will be cut by the next freshet. Fields can be easily drained of surplus water by plowing furrows and cleaning the ditches with this home-made implement.

FATTENING HOGS ON ALFALFA.

BY F. C. BARKER, OF NEW MEXICO.

MOST of our Western farmers were originally induced to embark in alfalfa farming by the tempting prices offered for the hay in the neighboring towns. But these markets rapidly became overstocked, and as alfalfa could not stand the high rate of freight necessary to get to more distant points, prices pretty generally fell to \$6 per ton, baled

and delivered onto cars. At this figure there is comparatively little profit, especially where land and labor are dear. Long ago I pointed out that this would be the sure result in every alfalfa raising country, and that the solution of the difficulty was to be found in feeding the alfalfa to stock.

Alfalfa is an excellent basis of food, both for milch cows and fattening steers, but in other cases it must be supplemented with other food, containing an excess of carbohydrates, that is heating and fattening ingredients, in which the alfalfa is deficient. In the case of cows, bran is most generally used, while for fattening others, corn and sorghum fodder has given the best results when mixed with an equal quantity of alfalfa.

For growing animals, however, alfalfa is an ideal food, without the addition of any other matter. It is on this account that young pigs do so well on alfalfa pasture. Many of these will get to over 150 pounds in seven months, with nothing but alfalfa, except during the last three weeks when it is advisable to add wheat shorts to their food, mixing 100 pounds of shorts to 500 pounds of alfalfa hay, which should be chopped up with a cutter and fed wet and well mixed up. Of course, corn or corn meal might take the place of the shorts.

To pasture hogs on alfalfa successfully, it is necessary to observe certain precautions. In the first place you need two pastures, so that one may be fed while the other is being irrigated. Be careful to have a good border between the two pastures, for if water comes into the patch where the hogs are feeding they cannot resist the temptation to root in the cool, moist earth.

The best means of preventing the hogs from rooting up and eating the alfalfa roots is to cut the hard gristle of their shorts. No amount of rings will prevent them.

One of the most important points is to see that the hogs have a constant supply of fresh drinking water. Hogs will not thrive if the water emits a stench. Even the pools they wallow in must be changed every week, and they should have a little coal oil and sulphur put in daily, so as to keep off vermin. It is a good plan to nail slats about six inches apart over the feeding and drinking troughs. This pre-

vents the hogs from getting into the troughs and wallowing in them. Cleanliness is all-important in hog raising.

Quarters should be provided in separate pens, should the pasture become wet with rains, as they will tramp out and ruin the alfalfa if the land is very wet. It is also very desirable that sunshades be provided.

While kept in the pens a little sulphur should be put in their feed, and also sulphur and coal oil and a solution of carbolic acid sprinkled over where they sleep. They should also have access to charcoal.

Under the above treatment our hogs in this vicinity are kept perfectly free of disease.

If the sows farrow in March or April the young pigs can, in this climate, be put upon the pasture at once and they will be fit to market in November or December, and the pastures will supply enough green food for the brood sows during the winter.

I have not said anything about the fences; but, of course, these must be hog-proof.

By the bye, the alfalfa in a hog pasture should be mowed once or twice during the summer, or whenever it begins to get hard and woody. This will provide plenty of young and tender herbage, which is more nutritious than forage from other plants.

As regards the number of pigs that may be allowed to run on each acre of pasture, of course this will depend upon circumstances. The best authorities say from ten to twenty head per acre; but at a conservative estimate of ten hogs to the acre it will be seen at a glance that the alfalfa will produce far more money, with less labor, than if the alfalfa is sold, baled, at \$8 per ton.

Hog raising on alfalfa will be one of the staple industries of the irrigated West, and I believe that in no part of the world can pork be raised so cheaply, or the animals be kept as free from disease.

HOW TO GROW WINTER GRAIN WHERE HARD WINDS BLOW.

BY CLINTON C. HUTCHINSON.

THE subject of this article is one which has interested the writer many years. In my "Resources of Kansas or Fifteen Years' Experience" published 1891, there is a description of the soils of the region known as "The Plains," which includes a

large proportion of the vast area between the Missouri River and the Rocky Mountains. Of this country, including Southern Nebraska and southward into Texas, I said: "With *deep plowing and deep and early drilling of the seed*, this is to be the great winter wheat storehouse of the nation."

The crops of several succeeding years confirmed this prediction, as the people were favored with what are known as "good years." Such seasons are to a certain extent detrimental to the permanent prosperity of any new country, because whatever is planted grows and thrives, whether properly plowed and tilled or not. The consequence is that farmers cease to study their new conditions, and ignore all suggestions looking to better methods, or the introduction of new crops suited to their new soil and climate.

The practice of harrowing or drilling winter wheat between corn rows is often so successful that many said deep plowing was unnecessary, and others who plowed deep said this only loosened their soil to a greater depth for the wind to blow away, cutting off the wheat leaves, and perhaps leaving the roots exposed to wind, sun and frost.

The theory which I would urge for trial—for it has never been tried to my knowledge—is based upon certain well-known facts. Winter wheat which is protected by corn stalks, high weeds, fences, hedges or groves, often yields a fair crop, while unprotected fields, under otherwise similar conditions yield little or nothing.

What I urge for trial, not only in Kansas but in all open countries where winds blow, is as follows:

Early in the fall plow deep and harrow fine. Neither hard ground nor lumps and clods furnish proper conditions for tender plant growth. Into this seed bed drill or harrow winter wheat, barley, oats or rye, and with it, or immediately thereafter put in one or two bushels per acre of any quick growing variety of Indian corn. The latter will quickly outgrow the small grain and if sown early enough will thoroughly protect the crop. Being cut down by frosts it cannot sprout again the following spring, and it will mulch and save the growing grain. Its broad smooth leaves will present a surface to the wind, which may be compared in its effects to the pouring of oil upon water in a storm at sea.

If this theory is correct, its value can hardly be estimated. In almost every portion of the United States there is always rain and sunshine enough in the fall of the year to insure a growth of small grain and of the corn, and the mulch of the latter will not only protect the grain but benefit the soil, when plowed under the next year. Just what amount of corn should be sown can only be determined by experiment, and it might be better to have a dropper attached to the plow beam and turn under the corn unless the plow runs too deep. There is not much likelihood of the plow covering the corn too deep; and putting in the grain afterward, even if the corn had come up, will help rather than hinder its growth.

WINDMILL CAPACITIES.

A CAUTION BY H. V. HINCKLEY.

REFERRING to the table on page 245 of the June AGE; I cannot allow such a table to go out to prospective pump irrigators without cautioning them on the following points: The average wind velocity in Western Kansas, for example, is eleven miles an hour giving about one-half the power of a fifteen mile wind. A successful irrigator will need one foot of water in 60 or 90 days instead of in 300 days. In other words, the areas given in column "Amount of land covered," if divided by ten, will be approximately the areas successfully irrigable. Thus a fourteen foot mill, lifting water 175 feet, will irrigate 2.3 acres instead of 23 acres. The actual results will depend upon the man, the layout of the plant, succession of crops and the like. It will be possible to double the acreages given by my rule but the result will oftener fall under my figures. I speak from the compiled experience of many irrigators.

ASHES AS A FERTILIZER.

HARDWOOD ashes make excellent fertilizing material, chiefly for the potash which they contain. Such ashes also contain lime, which is valuable on some soils, but hardly necessary as yet in very many fruit orchards. In buying ashes then, the main question is that of the potash they contain, and if the cost be more than that of potash in some other form, there is little or no profit in the purchase of ashes

for a field or orchard fertilizer. Professor Massey has shown in the "Canadian Horticulturist" that the great trade between Canada and the United States in Canadian ashes is profitable only to the transportation companies and the dealers. There is no profit in the business to the farmer who sells the ashes from his farm in Canada, or to the farmer who buys it for use as a fertilizer in the United States.

He found that ashes costing about \$5 per ton in Canada were sold at certain points in the United States at \$15, the difference of \$10 per ton being largely made up of freight charges. In such cases Professor Massey found that the Canadian farmer was selling potash from his land at two cents a pound, and that the United States farmer was paying more than six cents a pound, whereas he could get the same substance in other forms at from four and a half to five cents a pound. The business may be thus summed up: At the prices named the Canadian farmer cannot afford to sell ashes, and the United States farmer cannot afford to buy.

We sometimes see advertisements of hardwood ashes guaranteed to contain five per cent of potash, and a good many tons have been bought for use in American orchards. Of that grade of ashes, a ton would contain 100 pounds of potash, worth not to exceed \$5. From this it will be seen that he who pays much more than \$5 for a ton of ashes for fertilizing purposes pays too much.

The amount of muriate of potash imported in 1894, was 101,597,074 pounds, valued at \$1,540,081. All other forms of potash, except chlorate and nitrate, 28,623,629 pounds, worth \$702,269.

Of nitrate of soda (Chili saltpeter) the importations in 1894, were 98,136 tons, valued at \$3,189,084.

PROFIT IN RAISING LARGE FRUITS.

IN harmony with what THE IRRIGATION AGE has taken occasion to urgetime and again, upon deciduous fruit growers in general, the following from the "Canadian Horticulturist" is of interest:

The material composing large fruit is less costly than that which enters into the composition of small fruit. We use the terms large and small fruit to distinguish specimens of the same variety, as large Lombard plums and small Lombard plums, not to distinguish plums and cherries from grapes and currants.

Composition of Fruit.—Like other vegetable products, fruits are mostly composed of oxygen, hydrogen, nitrogen, carbon, potash, soda, magnesia, lime, phosphoric acid and sulphuric acid. With the exception of nitrogen, potash, and phosphoric acid, all these elements are abundantly supplied by the air or the soil. A deficiency of one or more of these three substances impairs the fertility of the soil, which must be restored and maintained by compounds containing one or more of these three elements. Each crop taken off the land carries with it a certain amount of these three elements, and lessens by so much the raw material at the command of the farmer.

Let us apply these principles in reckoning the cost of producing large and small fruit of the same variety. An apple three inches in diameter contains twenty-seven times as much substance as one only one inch in diameter, but the skins, cores, and seeds form a much larger percentage of entire substance of the smaller apple than of the larger one.

By a chemical analysis of the apple we find that the seeds, skins, and cores contain about twice as large a percentage of ash, and five times as large a percentage of nitrogen, as the flesh of the apple does. Not only is the ash of the refuse in greater abundance, but it is also richer in phosphoric acid. These facts show that the soil is more rapidly exhausted by the production of small fruit.

Injurious to the Tree.—The tree is more injured by a large crop of small fruit than by an equal weight of large fruit. The fruit tree which bears a heavy crop of small fruit makes very little growth of wood, while one which bears the same weight of large fruit makes sufficient wood-growth. Both the growth of the tree is retarded and its health is much impaired by an undue amount of seed. Besides this, the raising of large fruit is more profitable, because, it commands a higher price in the market.

An Ingenious Safeguard.—George A. Fleming, a fruit grower of Visalia, Cal., has devised so ingenious, simple and efficacious a scheme for protecting orchards from frost that it should be known as widely as possible, says the *Call*. It should be borne in mind that frost occurs only when the air is still. Hence fires built around an orchard will send their heat and vapors straight up into the air, while building them among the trees would be dangerous.

Mr. Fleming, after various experiments, hit on the following plan. He thus describes it: "We built wire frames on our low truck wagons, stretching them from four wagon stakes and heaping wet manure over them. Dirt was thrown on the wagon beds to protect them, and pots of burning tar were set underneath the straw roof. A barrel of water on the wagon was used to keep the straw wet. These

wagons were driven about and did the best work, as they could go wherever most needed. The smoke and vapor were carried to the rear as the wagon moved, and, being at once out of the rising heat, fell close to the ground in a long white trail. At daylight our whole 400 acres of orchard was covered with a white fog extending from the ground about twenty feet high."

That seems to be a perfect solution of the problem. The wagons may be driven among the trees or anywhere else, and the blanket of vapor left behind is a sure protection against frost. The idea is economical, the question of fuel being one that every grower can answer for himself.

Pear Blight in Texas.—Mr. H. M. Stringfellow some years ago planted an extensive pear orchard at Hitchcock, between Houston and Galveston, Texas, and for some years it was reported to be absolutely free from blight and the most profitable orchard of the kind in the country. But all that has changed. It has been found that what Mr. Stringfellow believed was an ideal location for pears was soonly for a short time, and that now the trees in that locality of which great numbers have been planted, are subject to the disorders which affect such trees elsewhere. From a letter in the *Texas Farm and Ranch* we take the following:

"I am just in from Houston and while there took a run down to Hitchcock to see the Stringfellow pear orchard. I was anxious to see how that fine pear orchard had fared, while blight was everywhere playing havoc with pear orchards. I found the old original orchard badly affected; the Kieffer worse than I have ever seen it here—which so far has been almost clear of blight. Le Conte was as badly affected as here. I was exceedingly sorry to see this. Thousands of trees of these varieties are planted and being planted around Hitchcock, Loma and Alvin. It is a grand sight to a fruit man, but when we think of the blackened ruin that it must come to in a few years, it makes us sad. We also saw the Satsuma orchard set out by Mr. Stringfellow, dead to the ground, on the trifoliolate stock. But when we think of eighteen inches of snow lying on the ground for several days it is no wonder that orange trees, even of the most hardy type died.

Calomel for Pear Blight.—The question of administering calomel to cure pear blight is attracting some attention in the Eastern States, and in this connection we give the gist of the claim made for this prescription by Dr. Hensley before the

Missouri State Horticultural Society some three years ago. The doctor alleged that the remedy had been successfully tried for twenty-two years, and he regarded it as practically infallible. He alleged that it had invariably cured the disease whenever tried. The dose recommended is five to ten grains administered by cutting the bark across the trunk and longitudinally, as in the operation of budding, turning back the bark, inserting the calomel, then closing the wound and tying it in place by means of a bandage.

While the lay mind may possibly be inclined to skepticism regarding the efficacy of this treatment, it can be easily tried by any one and the matter fully tested. The medicine should be applied in the spring when the sap is flowing freely.

Copper Sulphate as a Fungicide.—Professor Taft, of the Michigan Experiment Station, has much faith in copper sulphate as a winter spray for fungous growths of various kinds. He says:

"It is now about three years since a strong solution of copper sulphate first came into use as a fungicide upon the bare branches of trees before the buds opened, and the results obtained from its application have been so favorable that it is recommended by nearly, if not all, of the spraying calendars. When used at the rate of one pound to fifteen or twenty-five gallons of water, it destroys the mycelium of such fungi as winter upon the branches, and prevents the germination of such spores as may come in contact with it; but at this strength it will destroy the foliage, hence it cannot be used later in the season."

Prune Acreage in the Pacific Northwest.—In its splendid "Prune Edition," the "Rural Northwest" gave valuable statistics of the industry in Oregon, Washington and Idaho. From careful investigation the "Rural" has learned that prunes are grown in 20 counties of Oregon, in acreages ranging from 20 acres in Curry county to 5,000 acres in Douglass county. The total for the State is given at 28,370 acres. Washington produces prunes in twenty-seven counties, and the smallest acreage in any county is fifty acres in both Columbia and Kittitas. The total acreage is 11,500 acres. Six counties in Idaho produce prunes in quantity, and the total acreage is 6,450 acres, of which Ada and Canyon counties have 4,500 acres. Total for the three States, 46,320 acres of prune orchards.

Crops of Russia 1894.—Russia is a formidable competitor of the United States in the grain markets of the world, and a wide area is there devoted to the cultivation of cereals. Although too far north to yield Indian corn in great quantity, Russia's wheat fields are extending rapidly, and the early completion of the trans-Siberian railway will no doubt stimulate wheat production very materially to the disadvantage of the United States, for the wheat produced on cheaper land than ours, and with the ex-serf labor of Russia, can certainly be sold cheaper in the world's markets than any that can be grown in the United States under civilized conditions.

Last year's Russian crops follow.

	Bushels
Winter wheat.....	78,948,626
Spring wheat.....	208,698,418
Rye.....	821,594,904
Oats.....	687,876,308
Barley.....	186,718,218
Buckwheat.....	43,909,650
Millet.....	38,642,645
Maize.....	18,222,320
Peas.....	16,209,850

Condition of Crops in Spain.—During eight months previous to May 1, Spain had suffered from severe drouth. In March and April there were but two days of rainfall. Crops were threatened with almost total failure, and the poor with prolonged distress. But in May the drouth was broken with copious rains, accompanied by a windstorm something less than the St. Louis variety. Farmers feel encouraged, but there will be a short crop of wheat. The American consul at Denia, Andrew F. Fay, suggests that this is an opportunity for the United States to increase its exports of wheat to Spain, which has purchased abroad during the past seventeen years 126,666,600 bushels, or an average of 7,450,900 bushels per year.

Make Careful Selection.—A fruit tree that produces one dollar per annum is easily worth five dollars, making all due allowance for care and depreciation. If the same tree produces two dollars worth it is equally as well worth ten dollars. If there are sixty trees on an acre the difference in the value of that acre is as between \$300 and \$600. If there are one hundred trees to the acre the difference is as between \$500 and \$1,000. A due appreciation of this difference will cause every tree planter

to be exceedingly careful in the selection of varieties. We hear of single acres yielding enormous returns; it is generally due to the superior quality, and consequent fancy price of its fruit. It costs but little, if any, more to plant and care for the choicest varieties of any fruit, which have standing in the market and a ready sale, than for those which are only fit for stock feeding, and of trifling value for that.

Overproduction.—Commenting on the advice sent out from the Department of Agriculture, at Washington, that "the American farmer must change his way of doing business and put more brains into his work," the Denver Field and Farm says: "The American farmer has put so much brains into his work that he has, according to his political guardians, brought on universal distress throughout the country by producing too much. Overproduction is what ails the country, he is told, and yet he must put his brains to work to produce more. Our opinion is that he should put his brains to finding out just who it is that is robbing him of the fruits of his toil. He had better watch the money changers; the temple is full of them."

Feeding Alfalfa.—An experiment, carefully conducted at the Utah agricultural station in feeding alfalfa cut at different stages of its growth, has shown that steers fed on that which was cut just before coming into bloom made a gain of three-fourths of a pound a day. A second lot fed when the grass had been cut in the early bloom made a gain of only one-half a pound, while a third lot fed on late cut hay, after it was out of bloom made an average gain of only one-fourth of a pound per day. There is a lesson worth heeding in this. If you neglect your haying when the grass is just fit to cut, you are letting the dollars run away from you.

Hog Raising.—At the present low price for hogs the raising of them can only be profitable where most favorable conditions exist. Those who can make anything now, or who can make most when the market conditions are normal, are those who are in position to produce suitable hog feed at the least cost and where the attendance of the animals is least expensive. It is here that the irrigated farm, has a de-

oided advantage. Alfalfa, kaffir corn, potatoes, sugar beets and other feed can be produced with certainty and at least possible cost.

Advantages of a Creamery.—If a hundred farmers make the butter from five hundred cows, there will be one hundred different kinds of butter, and some of it will not be good—it may pretty safely be said that *much* of it will not be good. But if the milk be brought together and manufactured in a well conducted creamery the entire product may be of the best. If it be sent to market as the product of the one hundred makers, the poor will have undue influence and depreciate the price of all, while the creamery will obtain the top price for all.

Miles of Travel.—In cultivating forty acres of corn, or other crops, planted in rows three and a half feet apart, the team must travel ninety-five miles. To plant and properly cultivate forty acres of corn will, then, require about 350 miles of travel. The farmer who thinks of this and appreciates its significance will try to get the same amount of crop off twenty acres and save half the travel. The time saved will permit of doing a great deal for the permanent, as well as temporary improvement of his land.

Good Roads.—Farmers grumble at a trifling road tax and shirk in every way when the law compels them to work out their tax, yet there is no public taxation of such direct benefit to themselves. If viewed in the proper spirit the road tax will be the most cheerfully paid of any, and any farmer who has to use the roads he works, can well afford to give two days of honest work for every one the law requires. All that is needed is the proper disposition.

When to cut Alfalfa.—Tests have proved that alfalfa cut when it is in fairly full bloom is most nutritious as hay, or at least, produces the best results in feeding. If it is cut at that time there are other advantages of great moment. It will make another full crop in the season, and the new growth will start much quicker after the cutting. It is therefore worth while to watch closely and be ready to cut it just at the right moment.

Young Pigs Best.—A few years ago heavy hogs were in active request in the markets. Twenty years ago the average weight on the Chicago market was 300 pounds, but now it is hardly more than 230 pounds. Consumers have learned, in all parts of the world, that the quickly fattened pig less than a year old, makes the sweetest and most desirable pork meat.

Shipping Horses to Europe.—W. A. Hogan, of Jones county, Iowa, relates his experience in the *Alamosa Journal* as to a recent shipment of horses to Switzerland. He visited Lucerne and Basel. He says the supply of horses is short in Europe, and that a horse fit for carriage or saddle sells for \$200 and upward. The success was sufficient to justify another shipment.

Johnson Grass.—An exchange says that keeping Johnson grass cut off as soon as it appears above the surface of the ground will kill it. It may be so, but the farmer who begins when the first shoot makes its appearance will be the one most likely to succeed in thus eradicating one of the worst pests that was ever established in good land.

Gardening for Profit.—In successful market gardening the aim should be rather to produce the largest possible crop on the amount of land there is to cultivate. A large crop means a crop of good quality, too, in nearly all cases, and that is the only kind that brings the best price in the market. There is more clear profit in one acre well cared for than in five acres half taken care of. Next in importance to well prepared land and good seed is the proper plan or arrangement of the crops to be grown.

Ram Lambs.—The authorities are often asked for the number of ram lambs to place in a flock—that is, how many ewes should be allotted to each sire. A robust ram lamb may serve twenty or thirty ewes. More than that number will check the growth of an ordinary ram lamb.

Pedigreed Live Stock is having its day with good farmers and that day has not come any too soon either. If good keep, good surroundings generally, and intelligent selection are forces having any good

effect upon animals descended from the well kept herds and flocks of the country there can be no question as to the fact that all intelligent and honest breeders are on the royal road to permanent success, not only for themselves but for the live stock industry as a whole.

Washing Butter.—There is considerable difference of opinion in dairy circles on the subject of washing butter, the camps being divided into the washers and non-washers. Those who advocate the reduction of washing to the minimum claim that much washing injures the flavor.

Hemp.—Dr. W. H. Dunn, who raised 300 acres of hemp near Lincoln, Nebraska, is now working the crop into tow, which he will ship to eastern markets. He announces his intention of raising 1,000 acres next year.

Maple syrup from corn-cobs is the latest. By this discovery the cobs are worth more than the corn. Frank Shafer, of Lacon, Ill., boils clean cobs in water until soft. Then the juice is strained off and dark brown sugar added. This is boiled and it comes out a fine quality of maple syrup. It is also discovered in Iowa, in this instance, that a syrup can be produced from watermelons. The past season a melon grower in that State thus utilized thousands of surplus melons which in other seasons he has allowed to rot on the vines. The melon syrup has an exquisite flavor, has good body and a beautiful color.

Ginseng is being grown in Illinois. This root is worth almost its weight in gold. The Chinese regard this plant as a cure for almost every disease. They believe that the root possesses intelligence and powers of locomotion which enable it to run away to escape capture. They also believe that it is guarded by the tiger, the leopard, the wolf and the snake, animals appointed by the gods to protect it.

Australian salt bush has been tested in California and is a great success, growing to perfection on alkali ground where nothing else can grow. It is, like alfalfa, perennial, and everything that eats alfalfa

will eat it. A pleasant flavor is given by it to both butter and milk. If the California Agricultural College report can be relied upon this new grass or fodder will make vast tracts of worse than useless land the most valuable for dairy purposes.

An Illinois farmer living in Jewell county has discovered that seed corn soaked in coal oil renders the growing corn chinch-bug proof. He plowed up his wheat and planted the ground with corn. The seed of five acres was soaked in coal oil and the other forty was not. The bugs ate up the forty acres and never touched the five acres. It is worth a million if true.

Speaking of the great crops of North Dakota and the northward movement of the corn belt, B. S. Russell, of that State, advances a theory that is startling in its novelty. He insists that wheat is the pioneer of all cereals. Its office is to go ahead and serve as the civilizer of the soil; that is, to take the wildness, or, as he puts it, "the Indian disposition," out of it. He states as a fact that there were few instances where corn had been successfully raised until the land had first been cultivated in wheat.

Twenty-one thousand acres of land in O'Brien county, Iowa, forfeited by the Sioux City & Minneapolis Railroad Company, will be thrown open to settlement Feb. 27. Eight thousand acres will be taken by settlers who were driven from their homes when the government gave the lands to the railroad, but who are given the first chance at the land under a recent law.

It is alleged by the "Sugar Planters' Journal" of New Orleans, that many of the sugar plantations in that State have not realized 125 pounds of sugar per ton of cane, because of the use of antiquated machinery and appliances. There is a general need of replacing this old-time apparatus by the most modern type of sugar machinery, and the Louisiana papers are urging a forward movement on this line.

Some species of fish and insects do not sleep. Among fish, the salmon, pike, gold fish and some other species are known not to sleep at all, but some kinds of fish in-

dulge in periods of rest for an hour or two at a time. Certain species of fly are known not to sleep, and all the animalculæ belong to the list of those which sleep not, says the *Scientific American*.

Every man who plants trees should remember that in the present day and age nothing but the best fruits and vegetables pay to grow and ship; and when that is taken into account, the advantage of irrigation, which will insure a crop every year and multiply the productiveness of the land from two-to fivefold, becomes the more apparent.

The average production of peas in the Province of Ontario is about 14,000,000 bushels from an average area of 700,000 acres. Much of this product finds market in the United States. Much of the land in northern Minnesota, and probably in other parts of the northwest, is equally as well adapted to the growing of peas.

Egyptian planters are rapidly increasing the acreage of cotton planting in the valley of the Nile, and are improving their irrigation facilities for its culture. Irrigation in the southern and southwestern States would greatly increase the production and improve the quality of the crop in this country.

The orchard wagon with low wheels and broad tires, that will turn round within its own length, which will carry a load over soft ground without cutting in, fitted with springs to save jar, wear and horse flesh, has become a necessity where it has become known, and it comes to stay.

General Morin, of France, says that the deterioration of common roads except that which is caused by the weather, is two-thirds due to the wear of the horses' feet and one-third to the wheels of vehicles. Motorcycles and rubber tires would therefore minimize the expense of road repairs.

A red clay road well graded up and packed when dry, with good provision for drainage, can be made one of the best of roads by a coating of gravel, which becomes thoroughly imbedded in and cemented by the clay. It is one of the worst in its raw state.

There is a growing demand for family cows. Whoever produces them and complies with the requirements can get extra compensation for his labor and investment.

Capt. J. P. Casey, of Las Cruces, New Mexico, killed six Berkshire pigs last winter that dressed together 1,100 pounds. They were fed only alfalfa except 65 cents worth of shorts each to finish them off, and the meat was of superior quality.

The spray pump is found to be as useful in the garden as in the orchard, and is even being used to good advantage for preventing and destroying vermin on stock. Weak kerosene emulsion can be so applied as to meet every portion of the body.

Every farmer should raise some pumpkins in the cornfield. It is only necessary to plant the seed when the crop is "laid by," and they will do the rest. They fill a place in the domestic economy, both in the house and in the stockyard.

Dr. A. T. Peters, of the Nebraska State University farm, reports uniform success with the new method of dealing with hog cholera. A bulletin is to be put out, bearing on the subject, which will be extremely interesting to hog men.

Five hundred dollars from a half acre of blackberries, is given as the last year's crop of Mr. H. Blanchard, a New York grower. He thinks it requires the proper combination of man, soil and season, however, to produce such results.

Orange growers in the early belts of California might profit by budding some of the earliest good varieties, such as the Parson Brown, Early Oblong and Nonpareil, which ripen in Florida early in November.

It is said that not a quarter of the usual number of mares were bred this season. Such a policy will not have to be kept up long before there will be a scarcity of horses to meet even the present limited demand.

Fruit that is worm-eaten or disfigured by insects will not command either a fair price or ready sale. It is important to spray your trees and protect the fruit. It does not cost but a trifle of the amount saved.

It is only the excess of what a cow eats above what is required for its maintenance that yields a profit to the owner and feeder. The more they can eat and properly assimilate the greater the margin of profit.

For the garden, if possible, choose ground having a gentle inclination toward the south. Give it thorough drainage, deep cultivation and liberal fertilizing, and you will get good results.

Bubach, Crescent, Haverland, Warfield and Greenville, among the pistillate varieties of strawberries, stand in high favor among members of the Missouri State Horticultural Society.

Professor Bailey recommends a large increase in the area of land planted with apricots in the State of New York, and believes the tree there will prove as hardy as the peach.

Tests prove that grain fully matured and properly cured does not shrink if held during the winter. If not protected from vermin there may be waste, but there is no shrinkage.

In any kind of farming for profit, the problem is to get the largest return from the smallest outlay in the least time. This cannot be accomplished without thought.

The appearance of the corn shocks in the field after a harvest is a pretty good indication as to the character of the farmer, whether he is methodical or a slouch.

There is a big saving of labor and horse-flesh if you can make one acre produce as much as five usually does by intelligent treatment and care, and you can with irrigation.

If crops of any kind are planted between young trees, the irrigator must decide carefully the quantity of water necessary for each and apply accordingly.

Animals and fowls enjoy a fresh, cool drink as well as you do. It is not the best policy to permit their water supply to become warm and stagnant.

"Baby pork" from pigs not more than eight months old and weighing from 150 to 200 pounds to the carcass is now in the best demand in all markets.

Keep accounts with your fields, your animals and your poultry. It is just as necessary as for the merchant to keep accounts with his customers.

A duck lays large eggs, and nearly every day. It should have an ample supply of animal food in connection with grass and ground grains.

The dairyman need not see his lands run down in quality and productiveness unless he is inexcusably neglectful and shiftless.

Cement floors are the best for barn flooring. They are hard and smooth, are easily cleaned, save manure and are rat-proof.

Don't feed the pastures too closely. It is for better to divide and use the lots in rotation. It saves vitality for the grass roots.

Spraying should be done effectively. Both sides of every leaf and twig should be thoroughly wet with the mixtures.

The walk is the gait of a horse that should be cultivated and improved. It is especially so as to draft horses.

Ventilate the stable and the poultry house as carefully as you do your dwelling. It is equally necessary.

As you cannot change your climate it is the best judgment to study its conditions and conform to them.

A sound and healthy hen will lay because she can't help it, if you feed her the right sort of food.

No good neighbor will allow weeds to go to seed that may be scattered on the adjoining farms.

Ducks can be raised without a pond if you give them plenty of water to drink and to waste.

Discuss your methods with your neighbor farmers. You will get as well as give good ideas.

When you cannot twist any drops of sap out of clover stalks, it is safe to put it in the barn.

Irrigation will double the production of melon and cucumber vines, if judiciously applied.

A fat hen is a poor layer, and her eggs will either not hatch or will produce weak chicks.

Big corn cobs are not objectionable if there is big corn on them and plenty of it.

The younger you feed a pig, and the faster, the more profit there is in him.

Are your tools in good condition? If not, you may waste time and money.

Droppings left under fowls or animals are the breeding grounds of disease.

MAXIMS FOR THE IRRIGATED FARM

It is a good weed that dies young.

The proper study of the farmer is his farm.

Regularity is a first essential in caring for stock.

Any kind of a tree is a friend of man. Plant them.

The more a thing is worth the more it costs usually.

Good thinking is often a substitute for hard working.

Five acres well worked is better than fifty neglected.

Take care of your business and it will take care of you.

The mortgage is generally the heaviest thing on the farm.

The man who is wise knows best how little he does know.

It is as important to agitate for wide tires as for good roads.

It is sometimes the better economy to spend rather than save.

If you grow poor stock you may be sure of a lean pocket-book.

The best and easiest way of doing things is the most economical.

Slipshod work in any thing never produces satisfactory results.

The less cash a man has, the more necessity to use his brains.

Early training is as good for the four-legged animal as for man.

Good tools and the best machinery are the most reliable farm helpers.

Who abandons an old friend for a new one will not long have any friends.

The farmer who does not begin irrigating is sleeping on his opportunities.

A principle that should never be forgotten by the stock raiser—like begets like.

Cultivators of the soil should not overlook the necessity to cultivate the man as well.

Good treatment for the hired hand will make a large addition to the value of his labor.

Gardening cannot be learned in a day, a week or a year. No more can general farming.

A hard surface is out of place in the corn field, but it is just the thing for the road.

It is the finishing touch in almost every class of productions that yields the largest profit.

It is not good business judgment to buy good seed and plant them carelessly in poor land.

It is well to remember that your horses and cows have nerves, and to treat them accordingly.

The better the fruit the more valuable the tree. Take care, then, in the selection for an orchard.

Road making should begin at home. Well drained and bridged farm lanes are a paying investment.

The man who does not know what is in his soil can hardly be capable of judging what can be taken out of it.

There is no farmer who knows it all, and if he lived to be a century old there would still be something to learn.

By co-operation the farmer can buy at wholesale. If, then, he sells at retail he increases the margin of profit.

Make the farm home more attractive than the city homes if you would have your children stay there contentedly.

The difference of success between one man and another is generally in the quality of the brain rather than the work of the hands.

If farmers generally were educated practically on the farm, and under intelligent teaching, there would be fewer failures among them.

It is the American idea to give all public questions a public hearing, and it is as conducive to agricultural improvement as to political or social.

Many co-operative companies fail because of too much individuality in the management. True co-operation is by rule of the majority, all working earnestly to a common end.

THE PROGRESS OF INVENTION

THE spray pump promises to be as important an invention for the horticulturist as the cotton gin was for the cotton planter.

MR. J. F. DURYEA, the inventor of one of the most successful of the motor wagons, is turning his attention to its application to the farm wagon, and in a form that will permit of its being utilized to drive the wagon, a thresher or the stationary machinery of the farm. He considers it entirely practicable.

D. L. HOLDEN, a New York inventor, has perfected a method for making artificial ice at a cost not to exceed fifty cents a ton. It is an automatic plant whereby the evaporation of ammonia, which passes through large cylinders in a revolving tank filled with filtered water, will produce ice crystals that are compressed into available blocks.

A CARBON harder than the diamond has been discovered by M. Moisson. It is a compound of carbon and boron, produced by heating boracic acid and carbon in an electric furnace at a temperature of five thousand degrees. It will even cut diamonds, and is likely to supersede them for boring rock, cutting glass, and other industrial purposes. It can be produced in pieces of any required size.

Two machines, perambulating fumigators, have been designed for the United States marine hospital, to be used in exterminating epidemic diseases in cities. One is a chamber in which infected clothing and other articles can be thoroughly saturated with hot steam; the other is a sulphur fumigator provided with apparatus for disinfecting houses, the fumes being driven into the building through rubber hose. These machines can be sent post haste to any house where contagious or infectious disease breaks out.

THE bicycle represents the greatest carrying power, according to its weight, of any vehicle that has ever been constructed. Farm Machinery calls attention to this as a most interesting suggestion to the constructors of vehicles of whatsoever char-

acter. The freight car carries twice its weight twenty miles an hour; the farm wagon carries about the same proportion of load to weight not more than six miles an hour under the best conditions, generally not more than four; the bicycle carries seven to eight times its weight ten miles an hour, and apparently with no greater risk of breakage.

To produce a light without any carbon, such as is used in the incandescent light, is one of the great problems which Edison and Tesla have been striving to solve, and both have announced discoveries in this direction which are big with future possibilities. The principle has been discovered of producing light by electrical vibration, and Tesla claims that 200 times the light can be obtained from the same power. Edison has perfected a lamp which produces the X rays in a form that may be utilized for house lighting—movable lamps. He is simplifying and studying the process of construction, so as to make the invention of commercial value.

THE NEW LIGHT. — Edison announces that he has completely succeeded in producing a new light, which he calls the "fluorescent light." It is simpler than the incandescent and in every way preferable. The same style of globe is used, but the whole globe is aglow with a brilliant white light of wonderful illuminating power, instead of the carbon filament. Crystals of tungstate are welded to the inside of the globe, a partial vacuum is created and the light is produced by molecules of air in rapid vibration striking against the tungstate crystals. A low current of electricity is employed, and whereas in the incandescent light only 5 per cent is utilized as light, there is no perceptible heat from the new light. Its power is greater, at a much lower cost, than any light ever before produced. We have only just begun to get used to the incandescent lights through their general introduction and use, and now comes a substitute, which is likely to supplant them as rapidly as they were originally introduced, from the same inventor.

PULSE OF THE IRRIGATION INDUSTRY

RUSSIAN IRRIGATION.

AMONG the numerous visitors who were brought to America during the World's Fair, many were those who were interested in irrigation. Among them were visitors from Australia, France, Germany, Russia, Finland, and elsewhere. Several of them have since written descriptions of their trips through the West. Professor D. N. Golovneen, of Russia, Member of the American Society of Irrigation Engineers, has embodied the results of his trip in a volume of 100 pages with numerous illustrations, which has recently been issued. It is an extension of an article which he delivered before the Institute of Ways and Communication in St. Petersburg in which he is adjunct professor of hydraulic engineering.

Professor Golovneen expresses the conservative conclusion, "that in consequence of the energetic activity of the government and private men, accompanied with the development of irrigation science among the farmers, American irrigation will not remain in its present, though very high, state of development, but promises a further increase and financial success."

In a private letter to Professor L. G. Carpenter, of the State Agricultural College of Colorado, he states that private irrigation enterprises in Russia are few. Large government undertakings are projected and are being studied by commissions from the Ministry of Agriculture. Though not having new irrigation works, Russia has many ancient ones in her Asiatic dominions, some dating from the earliest times. The areas devoted to irrigation are very great. Some of the canals are very large, and irrigate extensive tracts of country. There are many traces of ancient canals of great magnitude, now abandoned from the encroachment of the sands, or from lack of water, and from stormy times in the past.

Professor Golovneen promises Professor Carpenter that in the future he will prepare a paper on the conditions of irrigation in Russia.

I. N. PEPPER,
of Stockton, Kansas, author of article on "Rooks
County Irrigation," in this number.

RIO GRANDE IRRIGATION AND LAND COMPANY.

WE learn from a private and reliable source that the capital for this concern was actually subscribed in London last month.

The object of the company is to build a dam on the Rio Grande river opposite Engle, New Mexico, and thence irrigate the whole of the Rio Grande valley as far down as Fort Quitman, Texas. Within this district about 50,000 acres are already under ditch and the proposed irrigation works will bring 180,000 acres more of valley land and 300,000 acres of mesa lands under cultivation.

The capital already allotted consists of \$2,000,000 in ordinary shares.

500,000 in 8 per cent preference shares
250,000 in 5 per cent debenture bonds
while \$500,000 of ordinary shares and

\$250,000 of debenture still remain in the treasury.

The directors in London are Colonel W. J. Engledue, Earl of Winchelsea, Lord Clanmorris, Lord Ernest Hamilton, Robert J. Price, M. P., John Ferguson, Dr. Boyd and R. Chetham-Strode.

The local directors are Mr. W. T. Thornton, Governor of New Mexico, Edwin C. Roberts, of El Paso, Texas, Joshua S. Reynolds, President of First National Bank of El Paso, Dr. John M. Yair and Henry D. Bowman, banker of Las Cruces, New Mexico.

The engineer of the company is John L. Campbell of El Paso, Texas.

If successfully carried out this will be one of the largest irrigation enterprises in the country, and later on we hope to be able to give further particulars in regard to the system which the company proposes to follow, and which embraces some features of peculiar interest.

THE AGRICULTURAL EXPERIMENT STATIONS.

Nearly forty-five years ago, a company of farmers joined themselves together in the little German village of Moeckern, near the city of Leipsic, and under the influence of the Leipsic University, called a chemist to their aid and (with later help from government) organized the first agricultural experiment station. Liebig in Germany, Boussingault in France, Lawes and Gilbert in England, and other great pioneers had been blazing the path of progress for years before. A great deal of research bearing upon agriculture had been and is still being carried on in the schools and universities, but the action of these Saxon agriculturists in 1851 marks the beginning of the experiment station proper,—the organization of scientific research and with the aid of government "as a necessary and permanent branch of agricultural business."

The seed thus sown has brought forth manyfold. In 1856 there were five; in 1861, fifteen; in 1866, thirty; and today there are more than one hundred experiment stations and kindred institutions in the different countries of Europe. Some are connected with the great universities or agricultural technical schools, others are independent and supported by societies.

In each of them, from one to ten or more investigators are engaged in the discovery of the laws that underlie the practice of farming, and in finding how they are best applied.

So rapid and so sure has been the progress of this enterprise in both hemispheres, that private persons, educators, societies, and governments have learned the usefulness and indeed the necessity of these institutions, not for the farmer alone, but for all who are dependent upon the products of the soil. The movement is extending to Asia and to South America;—everywhere, indeed, its importance is coming to be felt.—From "The People's Food—A Great National Inquiry," in *June Review of Reviews*.

PROGRESS IN NEW ZEALAND.

WHAT is yet but a hope or prophecy with us, regarding many questions of social and political importance, has become ancient history to the inhabitants of that little island country away off in the southwest corner of the world. Mr. A. D. Willis, a member of the New Zealand Parliament, was lately in this country, and gave the following information to a reporter for the daily press:

"There are over 2,000 miles of railway in New Zealand, nearly all owned by the government. Our system of managing them cannot be beaten. There is no corruption and not a single abuse. The telegraph system belongs entirely to the government.

Then we have a government system of insurance which works admirably. Through this we are abolishing all pensions. All government employes, including those connected with the railroads and telegraph system, are compelled to provide for their own insurance out of their salaries.

Our taxation is based on Henry George's theory of a single tax on land, but we have also an income tax. Land improved and unimproved pays the same tax. Under our income tax we exempt all incomes under £300 a year, and on incomes from £300 to £1,000 the rate is sixpence per pound. On incomes from £1,000 to £2,000 the rate increases from sixpence to a shilling, and on all incomes above £2,000 it remains a shilling on the pound.

Last year we adopted a system of lending money to farmers, on both free-hold and lease-hold lands, at a low rate of interest, with a 1 per cent. sinking fund, which clears off the loan in thirty-three years by compound interest.

In every way we look carefully to the interests of the mass of the people. Our factory girls are not allowed to work over eight hours

a day, children are not allowed to work in factories under fourteen years of age, and until they have passed through certain grades in the schools. We compel employers in factories to give a weekly half holiday. No shops are allowed to open on Sunday, and every shop must close one day in the week at 1 o'clock in the afternoon. The closing of the shops on Sunday was not at all on secular grounds, but simply to give employees a reasonable amount of rest."

FLOW OF IRRIGATION STREAMS.

THE following information is furnished by Prof. L. G. Carpenter, of the Experiment Station, Fort Collins, Colo.:

The Cache a la Poudre river is a stream typical of those of the eastern slope of the Rocky mountains, and is one of which there is the longest and the most continuous record. A self-recording instrument was placed on the stream in 1884. The years of high water in one stream are usually the same with others, as the meteorological conditions causing a heavy or light snowfall over the mountain watersheds are usually the same. So closely alike are the conditions of melting, that frequently the highest stage of water will be reached by a number of streams on the same day.

Up to the present date, June 17, the Cache a la Poudre has been unusually low, which the reports of light snowfall in the mountains gave reason to expect. So far, the year compares with 1888 and 1889, which were unusually low. The highest water, due to melting snow, was reached on May 29, when there was 1,900 cubic feet per second at the time of highest water of the day. On May 30 and 31 the river was higher, reaching 3,340 second-feet for a short time on the 30th, due to heavy rain. Since then the river has fallen steadily, and the daily fluctuation due to the melting by day and the freezing by night in the upper elevations, is becoming less noticeable. For the week ending June 9, the average was 1,378 cubic feet per second, while the average of the eleven previous years was 2,272 second-feet, showing a decrease of 900 cubic feet per second. For the week ending June 17, the average has been 1,180 second-feet, which is 800 feet less than the average for eleven years. This is 100 feet less than in 1888 for the same time, notwithstanding that in 1896 water is received from the Laramie river by works constructed within the last few years.

The following is the record for the year, and is worth careful consideration. The average only, for the earlier weeks, is given. For the past two weeks is given day by day, and the average for the same time for the previous years also is given:

Week ending.	Ave. 1896.	Ave. prev. y'rs.
May 12.....	*964	856
" 19.....	504	1083
" 26.....	1007	1535
June 3.....	1802	1846
" 9.....	1378	2272
" 17.....	1180	2013
Ave. of y'rs.		
June 10.....	2458	1896. 1854
" 11.....	2434	8200 1855
" 12.....	2326	2590 1163
" 13.....	2241	2780 1139
" 14.....	2226	2800 1144
" 15.....	2208	2950 1077
" 16.....	2110	3050 1027

Record of week June 10-16—average cubic feet per second:

1884.....	5118	1891.....	2386
1885.....	2626	1892.....	1364
1886.....	2258	1893.....	2515
1887.....	1978	1894.....	2140
1888.....	1280	1895.....	2967
1889.....	1888	1896.....	1180
1890.....	1238		

ARTESIAN WELLS.

THE following valuable and interesting information has been extracted from the volume on Artesian Wells by Walter Gibbons Cox, C. E.:

At the Carthusian Monastery at Sillers, France, is an artesian well still flowing that was bored in the twelfth century.

In Algeria and the Sahara desert 12,000,000 acres of land have been reclaimed and irrigated by means of artesian wells. The aggregate flow from all the wells is estimated at 80,000,000 gallons daily.

Prussia is credited with the deepest bore in the world, namely, that at Rybnik, Upper Silesia, made by the German government for scientific purposes. The depth to date is 6,565 feet.

In the United States the deepest successful bore for water is in Virginia, where the extraordinary depth of 5,060 feet was reached.

The Winton bore in Queensland, Australia, is 3,995 feet deep with a flow of 1,100,000 gallons daily.

There are two artesian wells in South Australia, each flowing 1,200,000 gallons daily.

*3 days only.

New South Wales has a well, 1,729 feet deep, flowing 4,000,000 gallons daily, and another 1,638 feet deep with a flow of 2,000,000 gallons.

With the exception of the Dakota basin the artesian basin of Queensland, embracing an area of 376,832 square miles is the largest yet discovered in the world.

At Burrandilla, Queensland, two starting overflows were secured, one of 4,000,000 and the other of 2,500,000 gallons daily. No. 2 bore at Charlotte Plains, depth 1,848 feet, 4,000,000. Coreena bores, No. 2 and No. 5 respectively 1,500,000 and 1,000,000. Tinnenburra, seven bores, threw out 8,000,000 gallons of fine water daily. Boatman bore No. 1 discharges 4,200,000. It is estimated that at the present time 350 private bores in the colony of Queensland are flowing over one thousand million gallons of water daily.

FRESH MINING NEWS.

It is predicted that the production of gold this year in California, Washington, Oregon and Alaska will be a considerable increase over that of 1895 which was \$2,384,560 greater than in 1894.

Copper mining seems to be especially prosperous. Extensive additions are being made to the smelting plant of the United Verde Copper Company, at Jerome, Arizona, which is already one of the largest smelting plants in the country.

The Rothschilds have bought the remainder of the interest of the Hearst estate in the Anaconda mines of Montana. They bought 270,000 shares in the last purchase on a basis of \$45,000,000 for the property, yielding about \$7,000,000 to the estate.

The Engineering and Mining Journal has twice recently made reference to the extraordinary activity in the development of Utah mines. From all over the Territory old mines are being more extensively worked and new ones of great promise are being opened.

The Bennett placer machine is in successful operation on Green River, Utah, by the South Park Mining Company. The machine is run by electricity, and performs every detail of placer mining automatically,

from shoveling up the gravel to saving the gold on the plates.

The new furnace of the United Verde Copper Company, at Jerome, Arizona, the largest in the world has been put in blast. By a new process, originating with local parties, the ore is roasted and treated with the same facility and in the same time as is required for unroasted ore.

The general deficiency bill which was passed in the last days of the recent Congress makes provision for the assaying and sampling of lead and silver ores that are imported into this country, principally from Mexico and British Columbia. Sampling works are to be erected at El Paso, Texas, Northport, Washington, and Bonner's Ferry, Idaho.

A company is being formed to construct a cyanide process plant at Atlantic City to treat the ores of South Pass in Fremont county, Wyoming. It will have a capacity for the treatment of several hundred tons a day, of which there are large dumps to be worked at that place. They are obtaining as much now from the tailings as was obtained from the first working of the ore.

The Engineering and Mining Journal in a recent issue speaks of the mining activity in Utah, which has come about through a change from the old-time conditions, and the substitution of foresight for hindsight. The introduction of new processes of treatment and more careful prospecting, especially directed to the discovery of gold is leading to wonderful changes. The Park City, Tintic and Bingham districts go steadily on producing and paying dividends, but with very little excitement. New discoveries of low grade gold ores are reported from the Camp Floyd district, and it is being demonstrated that ore of very low average grade can be profitably worked. The Geyser mill report for April shows the average value of the ore milled was only \$3.92 per ton. The entire cost of mining and milling was but \$1.97 a ton, and the profit on this low grade rock was therefore \$1.95 a ton. A fifty-ton cyanide plant, therefore, yields the handsome return of about \$100 a day on less than \$4 ore, and it is not truly free milling. There is a good deal of ore in the district that is of much higher grade and pays well when shipped to the smelters.

BRIEF ITEMS OF INTEREST.

A salt factory at San Diego, California, is producing 1,600,000 pounds annually.

Wool prices all over the West opened about two cents lower than last year, with lesser demand.

The inhabitants of Colfax county, Nebraska, are hunting eels with guns. The sloughs are alive with them.

The United States produces 4,000,000 bushels of peanuts, or one-sixth of the total production of the world.

There are now more than a million miles of telegraph lines in existence and more than half of them in this country.

There were 45,000 tons of commercial fertilizers used in Indiana last year, of which 15,000 tons was raw ground bone.

A Tom Thumb calf is one of the curiosities at Hartford City, Ind. At two weeks old it weighed but twenty pounds.

It requires 40,000 electric lights for the houses of the English parliament, and fifty expert electricians to take care of them.

When water freezes it expands with a force estimated at 30,000 pounds per square inch, and no material has been found which can withstand this pressure.

It is estimated there are 400,000,000 fowls in the United States valued at \$200,000,000. The egg product of last year was 1,200,000,000 dozen, netting \$150,000,000.

In 1870 the farmers in this country formed 47 per cent. of the population. In 1880 it had dropped to 44 per cent. and in 1890 to 40 per cent. And even now it don't pay—nor any other business, for that matter.

One telegraph reporter sent out the press reports of the convention at which Lincoln was nominated. It required 200 operators to send the reports from St. Louis. The country is growing in more respects than in population.

Statistics by the Department of Agriculture at Washington show a decline in the value of farm animals of \$755,580,597 since 1893. The greatest depreciation is in the case of horses, in which the aggregate decline for seven years has amounted to \$500,000,000.

There have been 2,396 of Spurgeon's sermons printed and the total sales have reached nearly 100,000,000 copies, or an average of 35,000 copies each. There cannot be much doubt that he exerted some good influence on the world by his busy life.

Edward Atkinson makes the statement that the product of the hen in the United States is of greater value than all the iron products of the furnace; that it is twice the value of the wool, and three or four times the value of the products of the silver mines of the country.

Chas. S. Hawkins, in the Indiana Farmer, after four years' use of the corn shredder passes judgment against them as being too slow, making the fodder cost too much, and as too dangerous because of the frequent choking and the risks involved in clearing them. He thinks they must be improved or abandoned.

It is estimated that more than 3,000,000 dozen of eggs are broken by the Chicago grocers in handling, and that as many more are cracked and sold at a loss of from three cents to five cents per dozen, the total loss reaching pretty nearly a round half million of dollars. The two combined are about one-fifth of all that are sold in that market.

A GLANCE OVER THE FIELD.

ARIZONA.

Choice fat cattle are being shipped from the Salt River valley to Denver in considerable numbers.

Territorial bonds to the amount of \$350,000 have been disposed of in Chicago, and the turning of that amount loose in the Territory is expected to ease up the financial stringency.

Whitelaw Reid, it is claimed by the Arizona Gazette, has offered \$15,000 for the Churchill residence, with a view to making a permanent winter home in Phoenix. The offer was declined as too low, but it was thought he might raise his bid.

Governor Franklin has absolutely refused to carry out the provisions of a contract which was entered into by the lately removed Governor Hughes with an Eastern syndicate, for the employment of the prison labor of the Territory. The Phoenix

Courier says of it: "Under this contract the company gets everything, the Territory nothing," and ventures the assertion "that no such contract was ever made by any corporation from the dawn of civilization to the present day. Solitary and alone, it stands a monument to corporate greed and official rascality."

CALIFORNIA.

Fresno is developing rich oil resources, and has recently shipped its first car load.

Riverside people are agitating for the establishment of a shoe manufactory in that city.

The yield of the Edward Cooper olive groves, near Santa Barbara, is 40,000 bottles this year.

Judge Waymire has given notice to the directors of the Turlock district that work is soon to be resumed on the big dam.

The Hermosa Water Company has run its tunnel about 160 feet, and a new tunnel two miles further up the mountains has been begun.

The shortage of the deciduous fruit crops, owing to late frosts, ranges from 25 to 75 per cent., taking the State as a whole.

The Tulare and Kern irrigation district, at Delano, is to be disorganized. Almost all the residents of the district are in favor of it.

San Bernardino has been having its first water famine. It is not generally popular, and the people are inquiring as to who is responsible.

The raising of pampas plumes is growing into a considerable industry in the southern part of the State. The market for them is found in Europe.

A lively excitement has resulted from the discovery of oil prospects in the San Timoteo and Reche canyons. Many stock companies have been organized by Redlands people.

The hay crop in the San Jacinto valley will be unusually heavy this year, as nearly all the barley fields in the valley will be cut for hay. Only a very small per cent. is sufficiently heavy for grain.

The Citrograph predicts that many orange growers will abandon the fruit exchange system next year, as it has not met

expectations, and has not yielded so satisfactory results as have the sales f. o. b.

The California supply of olives, for which the demand has increased materially, falls short of the present consumption between \$3,000,000 and \$4,000,000 worth, without including the \$7,000,000 that was spent for imported olive oil.

Senator John Beard, of Alameda county, planted an acre in locust trees ten years ago. He sold last season all the trees measuring six inches in diameter for ship timber, making \$648 by the transaction, besides cutting thirty cords of wood for use.

One factory has been established in Los Angeles, said to be the only one in the State, for the manufacture of orange marmalade and it is proving decidedly successful. The "culls" are used, which have no value for shipping, and the article produced is of high quality and commands a ready sale.

Mr. Scott of Covina, has been foremost in demonstrating that lemon growing properly conducted is an industry of largest importance to this country; but it will not permit of slipshod methods. It is distinctly a scientific business, and those who will not study the requirements had better let it alone.

Mrs. Stanford has turned over to the trustees of Stanford University the amount of the Senator's bequest to the University. \$2,500,000. The amount was in railroad bonds, which pay a monthly interest of \$10,000. The balance required to run the University will be given by Mrs. Stanford from her private funds. The great ranches which were given to the University do not more than pay their running expenses.

The Southern California Railway Company has adopted a style of ticket which might be copied to advantage in other localities and for other purposes. With it tourists can take in all the points on their system, in fact, ride all through and around Southern California, in any direction, by any of the routes, and at any time to suit their convenience, within three months, coupons being good in every direction.

The Redlands Citrograph mentions that oranges throughout the county are dropping from the trees in greater quantity this

year than was ever known in that section. It is attributed to excessively warm weather followed by a cold wave which started the sap running and then suddenly checked it. Instead of getting the heaviest crop on record, as promised a few weeks ago, it is likely to fall considerably short of last season's crop. The quality of the remaining fruit is not injured.

The Co-operative Packers Association are slow to join the combination of packers which they have been trying to make effective. They claim to have benefited their stockholders who are growers, to the extent of \$5 per ton. They state this as their proposition: To pack goods at cost; to sell them at cost; to employ our own members as far as possible; to get all the market will pay, and pro-rate the amount received to each grower in proportion to that which he contributes, according to quantity and quality.

COLORADO.

The prospects for crops were never better in this State.

T. C. Henry expects to settle 200,000 acres of land in the San Luis valley, Arkansas valley and vicinity of Fort Morgan, by Scandinavian, Russian and other emigrants.

Denver florists are not only supplying their own home market, but the mountain towns of the State, and Wyoming, with cut flowers. Denver has built many green-houses the past four or five years, and has completely taken the trade away from the Chicago and Omaha florists.

The Grand Junction News urges the necessity of a peach day celebration this year, in order to convince the public that the late frosts of the present spring did not kill all the fruit in the Grand valley. While there was some damage, they will probably have as much to ship out this year as last.

This State is promised by all odds the greatest tunnel on earth. The longest of the three tunnels under the Alps is less than ten miles, but this one, which is to start near Colorado City, is to be forty-eight miles long, with a branch line sixteen miles long, in the tunnel proper to Cripple Creek.

The Alfalfa Growers Association recently organized, has represented in its member-

ship 125,000 acres seeded to alfalfa, which yield an average total of 500,000 tons a year. Its value at \$5 a ton is \$2,500,000, and the Santa Fe road has established freight rates to Chicago, Kansas City and Galveston that will enable the grower to ship to these points and realize that price.

The farmers receiving water from the Handy ditch, near Loveland, one of the older ditches on the Thompson, having failed to get what they considered their proportion of the water, assembled in force, opened the headgates, in defiance of the county commissioners, and turned a full head of water through their ditch. They maintained their position for three or four days until their suffering crops had all the water needed. They evidently concluded it was better to stand a lawsuit than to lose their crops.

IDAHO.

The Reservation canal has been completed and the water turned in, near Idaho Falls.

From seven to ten car loads of settlers are to be brought into the Idaho Falls neighborhood from Iowa—so says the Register.

Floods in the Boise have done much damage in the neighborhood of Caldwell, washing away bridges and washing out considerable sections of the public roads.

KANSAS.

The little town of Pratt has decided to make no further effort to meet its bonded obligations, and will let the bondholders take the town.

A ten-foot Aermotor, and six-inch Stone pump have been purchased by the county and erected in the court-house square at Garden City to irrigate the lawns and park.

A forty-car corn train was started, with a great public demonstration, ex-Senator Ingalls being chief speaker, from Wichita, to attend the Republican Convention at St. Louis. It was five days en route and attracted great attention. It was a characteristic Kansas advertisement—in a good crop year. It ought to have been sent on to Kentucky and manufactured into whisky. Then it would have been available to keep up the enthusiasm until after the election.

The fact that the average depth of irrigation wells in Kansas is seventy feet, instead of twenty to thirty, as many people suppose, is an indication that the upland settlers are making an endeavor to solve the problem of the plains.

The Garden City Imprint says the outlook for small grains in the county is very discouraging up to the middle of June. The prospect for good crops in the early season was better than usual, but the hopes of the farmers were dissipated by withering crops. There is no water in the river to fill the irrigating ditches, and a short crop of alfalfa is therefore threatened.

MONTANA.

This State leads the column this year in the number of sheep within its borders.

An electric power company with \$200,000 capital has been organized to construct a dam across the Missouri river about fourteen miles above Helena, to generate power to be used in and around Helena for mining, manufacturing and lighting purposes.

The Milk River valley is one of the finest in Montana, especially for the growing of grains, vegetables and hardy fruits. The soil is deep and fertile, there is an ample water supply and a good climate. The valley is being rapidly settled with a class of industrious farmers, and its resources developed.

The Montana College of Agriculture and Mechanic Arts is located in the wonderful Gallatin valley. Magnificent college buildings, to cost over \$75,000, are in course of construction, and an era was reached in the history of this great educational institution about the middle of June when it graduated its first students. Governor J. E. Richards was present and presented the diplomas to the four students honored as being the first graduates of the college, and also conferred upon each of them the degree of Bachelor of Science.

This college here means everything to the interests of the State and especially so to this valley, known as the "Egypt of America," on account of its wonderful fertility and the marvelous crops raised on its lands by means of that promoter of immensity of productiveness—irrigation. This college has an irrigation engineer,

and the fact that this country, once a barren waste, is now producing crops of barley, wheat and oats, the yield per acre exceeding that of almost any other section of the United States, and unexcelled in quality, is an omen of the importance of a professorship of this kind to the farming interests of this State. Irrigation is a science, and the acme of perfection is being realized with wonderful returns for every cent expended in irrigation in Montana.

NEBRASKA.

There is a promise of exceptionally good crops this year, and now the people are ready to cultivate the harvest excursions.

The McCook Tribune advocates sending a county exhibit to the Nebraska, Iowa and Illinois State fairs, for advertising purposes.

A Saline county farmer has 100 acres of popcorn planted this year. He has found it a profitable crop, which meets ready sale generally, in the Chicago market.

The "Irrigation Annual," published by the State Association, is a fine volume, filled with interesting information and well illustrated. It does credit to A. G. Wolfenbarger, of Lincoln, the President of the Association, who proposed it.

The State Engineer-Secretary of the Board of Irrigation has allowed the claim of the North Loup Company for water from the North Loup river in Valley county, sufficient to irrigate a thousand acres, conditioned upon the company applying the water usefully to the purposes of irrigation before September 1, 1899.

NEW MEXICO.

Work on the beet sugar factory at Eddy, in the Pecos Valley, is progressing rapidly.

Stock shipments from the northern part of Grant county have been the largest ever known.

The Western Homestead Irrigation Company is doing a big lot of work on the Rio Puerco. P. E. Harroun is the engineer in charge.

This Territory and Arizona are sending more fat cattle to market each week, and are furnishing more feeders for the northern ranges than any other portion of the United States. So says the Stock Grower.

The Deming Land and Water Company, beside paying off almost the entire floating debt, have taken up \$50,000 of their bonded debt in the past year by the sales of land to original bondholders. The demand for water is steadily increasing, and the company is in every way prosperous.

The recent floating of the Rio Grande Irrigation and Land Company in London is, when the real facts are known, hardly encouraging to American promoters of similar enterprises. Before the stock was offered to the public, nearly two-thirds of it was underwritten by parties, who, for a consideration in the shape of a share of the promoters' profits, guaranteed to take stock in case the public failed to subscribe, and, as the public did not respond very freely, the underwriters had to take up the shares. The concern was very extensively advertised and, if successful, will encourage investors in irrigation enterprises, but in the meantime it is pretty evident that irrigation securities are not looked upon with favor by the general public.

NORTH DAKOTA.

Water was struck on the Buttke farm in an artesian well that probably has the strongest water flow ever secured from a shallow well in the Northwest. The water burst the pipes far below the surface, gushing out for many feet around the original opening, heaping up immense quantities of sand and debris.

W. W. Barrett, the State Superintendent of Irrigation, is an earnest worker in behalf of the forestry interests. He is now advocating what he terms the Sylvan system, which provides for the planting of trees by the school children.

OKLAHOMA.

H. V. Hinckley of Topeka, Kansas, furnishes the following interesting statement:

In the report made to the Governor by the delegates to the Albuquerque Congress is found the following: (See bulletin 18 O. K. Ag. Ex. Sta. page 14.)

"Some statistics furnished us by the secretary of the Kansas Irrigation Commission will prove interesting in this connection. The average cost of different

kinds of power for elevating water for irrigation, as compiled by that commission, is as follows: Horse power, \$73.75; windmills, \$118.31; steam engines, \$283.12; gasoline engines \$486. *From these figures we may justly decide* in favor of the windmill as the proper power, although it is more expensive in first cost than the horse power, but it requires no attention after once in operation."

We trust that our Oklahoma readers will take these figures only for what they represent. The average cost of the pumping plants, with no data as to water lift or acreage irrigable, gives absolutely no idea of the relative merits of the various powers for any given case.

SOUTH DAKOTA.

More land is being put in shape by irrigating by artesian wells, windmills, etc., in this State than ever before.

The Huronite has been a long time agitating for good artesian wells at \$1,000 apiece, and it is now announced that they may be had for that throughout the Jim valley.

The Dakota Farmer protests against the waste of millions of acres of unused grass of a quality so rich and nutritious that no tame grasses can surpass, if they equal it. In the older States the meadows are the most profitable parts of the farm. The point seems to be well taken.

The business men of Chamberlain have agreed to give \$250 in cash, and also to get a list of four hundred cows from which the owners will guarantee to deliver the milk they produce to L. D. Beardsley of Mapleton, Minnesota, as an inducement to start a creamery.

Aurora county has forty-one artesian wells. Thirty-five are owned by farmers and used for irrigation and stock watering, the other six are owned by townships and cities and are used for stock and fire purposes. The wells range in size from two and a half to seven inches, and are from 475 to 1,000 feet deep, with a capacity of from 50 to 600 gallons per minute.

The Milwaukee road has an irrigated farm near Melleite. Nearly 400 acres will be under water. Twenty acres are devoted to experiments for the testing of seeds, grasses, vegetables and trees.

There are also of farm crops, potatoes, 220 acres; oats, 200 acres; wheat, 160 acres; millet, 40 acres; corn, 40 acres; barley, 100 acres. The Salzer Seed Company is also conducting experiments there. The Mellette Tribune is especially an immigration organ. Last year the Milwaukee road adopted a policy of running excursions to the farm, which they will continue this year.

UTAH.

Active development work of the coal mines has been begun in the neighborhood of Provo.

The advantages of spraying have been so apparent in this State that the legislature provided for county and State inspection, and makes it obligatory upon all fruit growers.

The first sale of State bonds to the amount of \$200,000 has just been effected, Edward H. Jones & Co., of New York City, being the purchasers. They paid a premium of \$8,000 on 4 per cent bonds, indicating the high credit of the new State.

The Millard Progress reports that cold weather and heavy snows have proved disastrous to nearly all the flocks in the leading sheep districts of the State, causing a loss of ewes and sheared sheep to the amount of many thousands of dollars.

The big reservoir in Three-Mile canyon, south of Hyrum City, burst its banks on June 7, and a solid wall of water, sixteen feet high, carried destruction before it for a distance of thirty miles through the valley. Fields were covered one to four feet deep with sand, trees and boulders.

The machinery of the Big Cottonwood Power Company has been set in motion, generating 3,000 horse-power, which is to be transmitted to Salt Lake City, and to several mining camps. Under the direction of R. M. Jones this great work has been brought to a successful completion under difficulties which few would care to encounter.

Under the new law it is provided that before April 15 of each year every orchard and vineyard and every single tree grown on a lot or parcel of land, shall be thoroughly cleaned of all dead leaves and other debris, which shall be destroyed

by fire. The ground must be kept clean of anything that is likely to breed disease or insects.

A snow slide into Morgan lake, above Park City, forced the waters out of its banks, and for a time it was feared that much damage would result to mining property. When the flood had passed, the road was found to be gullied to the depth of five or six feet, but the damage was promptly repaired, and there was no occasion to suspend work at the mills and mines.

The accomplishments through co-operation are well illustrated in the little city of Midway. The people joined in an expenditure of about \$10,000 for the construction of water works. The cost was only about \$20 to each family aside from the work they contributed, and every family shares in the use of the water. Nowhere has co-operation had more practical illustrations than in Utah.

Inquiry has been made from London capitalists as to the terms for power in Salt Lake City for an establishment that will employ 2,000 workmen. The Tribune well says: "There should be a dozen great manufactories established in this valley; great chemical works, great glass works, great iron and steel works, and other works to convert the rare crude materials found in such variety and abundance in this region into commercial forms."

WASHINGTON.

The Yakima Herald deploras the action of people in its community who have instigated injunction proceedings to stop work on the Reservation irrigation canal.

Irrigation has made a wonderful change in Yakima county. The introduction of alfalfa and its utilization for stock feeding, and the incidental growth of the cattle and sheep industry, is substituting the hop raising industry.

Creameries are becoming common in all parts of the State, but Kittitas which was among the first to establish them, claims to be well in the lead, having gained the experience which puts them on a safe footing with success achieved.

Spokane men have purchased Sylvan Lake, in Lincoln county and will make it

a game and fish preserve. It is noted as a rendezvous for ducks and every encouragement will be offered to induce the ducks to make their homes there. The lake is also to be stocked with black bass, although it is well supplied already with finetrou. A club-house is to be erected and every convenience will be provided where true sportsmen may enjoy the pleasure of trying their skill as a marksman without killing game at wholesale.

Up to the present time all local reports go to show that the grain crop prospects are the best in the history of Eastern Washington. There has been, thus far this season, much more rain than usual. The latter part of April, the month of May and the forepart of June, gentle showers have taken place nearly every other day contributing largely to the above condition of the crop prospects.

The stockmen have about completed their roundups, and they report that the ranges are the best and the stock looking the finest for this season of the year in the history of the business. Buyers are now on hand and prime fat beeves are being shipped to market at very fair prices.

Fruit prospects now are that the apple crop will be the largest and most valuable ever known. The season for berries and small fruits is from ten days to two weeks behind the average on account of the lateness of the spring, and will be somewhat under the average in quantity on account of the late frost in the majority of the fruit growing localities; yet quite a large amount of small fruit of very fine quality is being shipped to market. Pear and prunes will be below an average crop. This favorable weather continued will insure a harvest of a very fine quality.

While the Western and South-western States along the Mississippi valley from Minnesota to Texas are being swept with terrible destructive freshets and cyclones, destroying hundreds of lives and millions of dollars of property, Eastern Washington which has never experienced anything of this kind, is enjoying an ideal climate favorable for health and comfort, and a most luxurious vegetable growth insuring ample return to the cultivator of the soil.

WYOMING.

The Fetterman canal, near Douglas, has been completed, and is in operation.

There has been more ditch building in the Big Horn country this year than in any previous year.

The ranchmen of Ranchester are about constructing an immense reservoir for irrigation purposes.

In a case carried to the United States Supreme Court from this State, it has been decided that the Indians must submit to the State laws as to hunting on the public lands, except within the designated hunting districts.

Secretary Smith has directed the Commissioner of the General Land Office to make contracts for the survey of thirty-nine townships in this State, in order that the State may make selections of school land, as provided by the act of admission.

State Engineer Meade assures the managers of the Trans-Mississippi Exposition, to be held in Omaha in 1898, that Wyoming will improve the splendid opportunity it will offer, to make a comprehensive exhibit of the resources of the State.

A pipe line twenty-one miles long is to be constructed for mining purposes on the Sweetwater, application having been filed with the State engineer. It is proposed to mine a tract embracing nearly 6,000 acres. The pipe is to be three feet in diameter, and the cost of the work is estimated at \$225,000.

A section of land ten miles square, in one corner of the Shoshone and Arapahoe Indian reservation, has been purchased by the government, and will be converted into a reserve and held as a National Park. It includes the famous Hot Springs, at the head of the Big Horn river. These springs are noted for the cure of rheumatism. Although the mountains were still full of snow, Inspector McLaughlin, who negotiated the purchase, found twenty-five white men there, all invalids, who had been carried through the mountains on cots, but were all walking about when he was there.

AMONG THE PAPERS.

In these days the genius and perceptive faculty of man is making such marvelous use of the powers and resources of nature that everybody is interested in following the developments. A monthly publication, "New Ideas," keeps close

tab on everything of public interest, either in the way of new inventions or improvements on old ones. It is published monthly at Philadelphia.

The "Practical Farmer," of Philadelphia, occupies a unique position among the agricultural press. It submits all sorts of practical farm questions to those most experienced in the specialties, and publishes answers of inestimable value to its readers. The weekly letters of T. B. Terry are of themselves a feature which ought to give the paper a hundred thousand subscribers.

"Practical Irrigation and Fruit Growing" is the title of a new paper just started at Roswell, N. M. As its name indicates, it is to deal with practical questions, and it should be of great benefit to irrigators, especially those in the Pecos valley where it is published. *THE AGE* is always glad to welcome new papers relating to irrigation, a journalistic field which *THE AGE* created.

"Greater Texas" is the name of a new publication which comes to our table, which shows rather extraordinary editorial ability. Its comprehensive grasp of the practical questions, upon the solution of which the future growth of that great State—immense in area and equally so in resources—and its admirable discussion of them, cannot fail to make it a power for good. It shows excellent judgment in its appreciation of irrigation as one of the leading factors in the development of its latent wealth, and its advice may well be heeded. Texas has at length succeeded in securing from the general government its assistance to improve the harbors of the gulf coast, and three of them are already open to the larger class of merchant ships. With its favorable climate, rich soils and accessibility to ocean transportation, it will start in the race with the interior agricultural States with many substantial advantages.

BOOKS AND MAGAZINES.

Artesian Wells as a means of water supply. By Walter Gibbons Cox C. E. Published by Capford & Co. Brisbane, Australia. American Agents, Van Nostrand Company of New York. Price \$3.00.

This book written by a prominent engineer of Australia is filled with information of great importance to those interested in irrigation. It gives the history of arte-

sian water supply from ancient Biblical times to the present, including the experiments and results of boring in America, Europe, Africa and Australia. Naturally, the chapters relating to Australia are more numerous than those of other countries. The geological conditions affecting the flow of artesian water, analysis of water, temperature, effects on climate are all ably treated. The author has used good judgment and care in selecting material and he has handled the subject in a thorough, practical manner. The volume should be in the hands of all irrigation engineers.

C. STIRLING, M.D.

WONDERLAND 1896.

By Olin D. Wheeler. Northern Pacific Railroad. Chas. S. Fee, General Passenger Agent. St. Paul. Six cents in stamps.

The 1896 edition of "Wonderland" issued by the Northern Pacific Railroad is beyond comparison the most interesting of tourist publications. Beginning with a description of the transcontinental train, as it waits in the depot at St. Paul before starting on its long western journey, it closes with valuable information about far-away Alaska. From first to last it is filled with graphic word painting of the grand, inspiring and beautiful scenery from Minnesota to the Pacific Coast and it is illustrated in a most luxurious manner. The pictures and description of scenes in the Yellowstone National Park are especially worthy of attention, and tourists and sportsmen will be particularly interested in the accounts of exploring and hunting trips indulged in by the author, Mr. Olin D. Wheeler. It has become a confirmed habit with the passenger department of the Northern Pacific Railroad to issue annually a new "Wonderland" book and with each succeeding issue the work becomes more and more interesting, and this year's number with its startling cover in black and red is worth many times the six cents in postage for which a copy will be sent to any address by Mr. Chas. S. Fee, General Passenger Agent, St. Paul, Minn.

American Newspaper Annual for 1896. N. W. Ayer & Son, Philadelphia, Pa.

This is one of the best and most reliable newspaper directories issued and the present edition lists the enormous total of 21,225 publications including the United

States and Canada. In the State of New York alone there are 187 daily newspapers; 1,151 weeklies and a total of 1,949 for all kinds of publications. In Pennsylvania there are 197 dailies and 972 weeklies, with 1,446 as total number of publications. The following table of publications shows that the Western States and Territories are not unprovided with reading matter:

Place.	Daily.	Weekly.	Total, all kinds
Illinois.....	156	1,210	1,366
Texas.....	67	636	751
Kansas.....	49	619	715
Nebraska.....	29	570	649
California.....	102	458	647
Colorado.....	35	226	290
S. Dakota.....	21	231	272
Washington.....	17	194	280
Oregon.....	18	149	198
N. Dakota.....	9	124	189
Oklahoma.....	8	112	129
Montana.....	12	79	100
Utah.....	10	44	68
Idaho.....	4	57	66
N. Mexico.....	5	47	57
Wyoming.....	5	36	42
Arizona.....	9	29	38
Nevada.....	9	15	26
	565	4,836	6,077

The appointment of W. T. Hornaday as superintendent of the proposed Zoological Garden in New York lends interest to the article in the July Scribner's, by J. Carter Beard, the animal painter, on taxidermy, which he calls "A New Art." He describes Mr. Hornaday's work as showing the best existing specimens of the art.

Rudyard Kipling, as he shewed himself to his intimate friends just before he became known to all the world, will be the subject of a paper in McClure's Magazine for July. It is written by the man with whom Mr. Kipling was associated in the editorship of a newspaper in India, and it will be illustrated with portraits and other pictures from photographs furnished by Mr. Kipling's family.

Professor Peabody, of Harvard, who is a member of a committee, consisting of President Eliot, President Walker, President Low, Charles Dudley Warner, and others, for the investigation of the drink habit in Boston, and of the different substitutes for saloons that have been established there, sets forth in the July number of "The Forum" some of the results of this important investigation.

THE AGE AS A DIRECTORY.

Read the advertising pages of THE IRRIGATION AGE carefully. They contain announcements and information which may be of great value to you. Our advertising department constitutes a directory of a great variety of machinery, implements, tools, and appliances for irrigation and farming purposes, as well as the names of engineers, lawyers and others who make irrigation a specialty, and moreover these advertisements are inserted by companies, firms and individuals whom we know to be reliable. If you don't find what you require, write us and we will be pleased to place you in communication with some responsible party who can supply your wants. We especially request all our readers to state that they saw the advertisement in THE IRRIGATION AGE when writing to advertisers. This will insure prompt attention to your letter, and will also show the advertiser that it pays him to patronize our columns, a point that is quite as important to us as to the advertiser.

WRITE FOR INFORMATION.

Don't hesitate to write THE IRRIGATION AGE whenever you desire information. If we can't give it to you immediately, we get it as soon as possible, and it won't cost you anything.

ALMOST OVERPOWERED.

A wild-eyed man, with his mouth out of joint, was found leaning against a lamp post on Fulton street.

"What's the matter with him?" yelled the crowd, as it ran up.

"Give him air," replied the policeman; "he's a stranger, and he tried to say Tchoupitoulas street."—*New Orleans Times-Democrat.*

ONLY FIFTY CENTS.

Fifty cents pays for THE IRRIGATION AGE for the balance of the year. This comprises Vol. X complete. Every subscriber who sends us five of these trial subscriptions will have his own subscription extended for one year from the date of its expiration. Every subscriber who sends us ten of these trial subscriptions may retain two dollars in cash.

We Want Silver

and will furnish you cards for sending fifty cent pieces by mail safely.

TOPICS OF THE TIME

Irrigation in the East. Gradually it is dawning on the farmers of the older States that the benefits of irrigation need not be confined to the plains of the West. There are few farms in the eastern States that are not "well watered," and every such farm may have its product increased and insured by a comparatively small expenditure, mostly in labor, by conducting the water from a running stream or from an artificial reservoir, which may be cheaply constructed. A farmer in New York recently stated that he had never known a year when there was rainfall enough to produce one full crop. A few plow furrows supplemented by the use of a common scraper will carry the water along the hillsides into the main laterals for the fields to be watered. Lay out the rows so that water will run between them, not too rapidly, and turn it in when it is needed. There is almost always a week or two during the growth of a crop when a little additional water would add largely to the product. It should be remembered, too, that the preparation for irrigating will provide for carrying off surplus water as well, a matter of hardly less importance. Every farmer ought to, and every progressive farmer will, read up on irrigation and its benefits. It will pay.

Adjustment Necessary. American farmers, by their prompt adoption of improved machinery and methods, are producing so much of the general products of the farm as to compel a dependence on foreign markets for the disposal of the surplus. In those markets they are meeting competition from countries where cheap labor and the silver standard enable the production of this class of products at a price which will not afford our farmers any such profits as they have formerly enjoyed. So long as we offer our surplus on the European markets, the price for our entire product will be fixed by the price at which we must sell the surplus. The only practical remedy is to reduce our production in those leading crops to the home consumption, or else to so stimulate the

home consumption as to make a market for all that we do or may produce. If, for instance, a portion of the land devoted to wheat should be turned to sugar producing, there is room for the substitution of nearly \$150,000,000 of sugar that is annually imported. A similar substitution may be made as to many other products which we now import largely, but which might be produced at home. The curtailing in one line and expansion in others would seem to be the sensible thing for our farmers to consider.

Industrial Paradoxes. Bursting granaries and starving tramps, low-priced corn and hay and neglected animals, full crops and widespread destitution, unequalled manufacturing facilities and restricted consumption, a wonderful progress in invention and inability to profit by it, stockholders of corporations getting richer and their employees getting poorer. These are existing conditions that none can dispute. There are reasons for it, and there are remedies. Where are the statesmen who can grasp and change the situation?

Controlling the Floods. When the river and harbor bill was under discussion in the senate, on motion of Senator Warren of Wyoming, an amendment was adopted providing that engineers of the war department shall make examinations in Wyoming, Utah and Colorado, and report to Congress whether it is practicable and desirable to impound the rivulets and streams of the mountains in reservoirs, and thereby prevent the erosion of the banks of the great rivers of the Mississippi valley and prevent damage from floods, the water to be used for irrigation of lands now arid. The word irrigation had to be eliminated as not germane to the purpose of the bill, but with that left out the amendment was adopted. It matters little how such an examination is accomplished. It can hardly be done intelligently without showing the vast benefits to flow from the holding of the storm waters for the double

purpose of watering the choice plain lands and maintaining a steady and uniform flow in the lower Mississippi and the Missouri rivers.

A Wedge Inserted. An amendment by Senator Warren to the River and Harbor bill, providing for an appropriation in the interest of irrigation development is a new departure, and all the interior States of the West are directly interested in it. Heretofore such appropriations have been almost wholly confined to the ocean coasts and large rivers. The amendment in question provides that surveys shall be made with a view to impounding the head waters of the large rivers, with the double purpose to prevent floods in the lower rivers, and to provide for irrigation in the valleys below the reservoirs.

Pestiferous Reformers. Professor Bailey, of Cornell University, makes some strong points in an address which he delivered before the Michigan State Horticultural Society. He claims that but for the pests which we must eradicate to save the crops there would have been slower progress in improving methods of culture, and there would be less stimulation for the cultivation which is necessary to secure the best results. He cites the influence of the potato bug, the Canada thistle, peach yellows, etc., which at one time and another have threatened the destruction of great industries, as productive of pronounced improvements in the treatment of land and plants, and as enforcing the necessity for careful selection of varieties and an exhaustive study of the conditions which surround them. He finds ground for hope that the apple scab will revolutionize apple culture in the East and that the Russian thistle which has made its appearance in some of the Eastern States will also wake the farmers up to deeper thought and more vigorous action.

Western Enterprise. It is a great piece of work that is being done in the Ogden canyon, Utah, it being only second in magnitude to the great power plant at Niagara. A body of water, as large as can be carried through a pipe six feet in diameter, is delivered under a head of 560 feet and under a pressure of 200 pounds to the square inch. The lower portion of the immense pipe is made of $\frac{1}{8}$ inch sheet

steel, which is shipped there from the rolling mills in sheets eighteen feet long and nine feet wide. A well-equipped machine shop for the manufacture of the pipe has been constructed, having bending rolls, punching machines and riveting machines of the most approved patterns, of immense power. There will be a mile of the steel pipe and five miles of wooden pipe of the same diameter, for which 200 car loads of Oregon pine will be used in making the staves. Ten thousand horse-power will be made available by this construction. The men who conceived and have carried this work forward with such effect that they can announce its completion by October of the present year, and in times like these, will hardly be denied credit for courage, boldness and enterprise. Senator Frank J. Cannon is president of the company.

Wasted Water. Professor Boggs, of the Arizona Experimental Station, calls the attention of irrigators to the great loss of water which results from the use of an excessive number of small laterals. The waste from both evaporation and seepage in such a climate as that of Arizona, or, for that matter, in any of the arid States, is a very large proportion of the total supply, when it is carried for long distances. Where water is scarce it is worth while to consider carefully the location of such ditches so as to limit the number of them, and wherever at all practicable such ditches should be substituted by pipes, or be lined with stone and cement. It is not good business judgment to expend large sums for the conservation of a water supply and for the lack of a little further expenditure permit the loss of a half, or more of it.

Wisconsin Irrigation. The Wisconsin Experiment Station made some tests of supplementary irrigation last year which fully confirmed the good results obtained by Dr. Gapen in Illinois. The yield of corn was increased over 300 per cent, as compared with a non-irrigated crop alongside. Three and a half acres of clover were irrigated at a total cost of \$18, with a net gain of five and a half tons of hay, and thirty-one days' pasture for fifty-eight sheep. The time is not very far distant when farmers generally, in all States, will

see the advantage of providing for irrigation, so far as their situation will make it possible, as a protection against temporary drouths. It is decidedly the cheapest policy of crop insurance.

New Route To Europe Not less than three of the Texas gulf ports have been so improved as to admit vessels of deep draft to their wharves. Railways to each of them have direct connection with all the Western States, and the farmers west of the Missouri are anticipating favorable results to flow from this opening for new lines of commerce. It is being demonstrated as entirely practicable to ship corn via the gulf to Europe, and it is likely to create an active competition between the roads running east and those to the south, and all to the advantage of the western farmer. Beef, too, that sells for four cents a pound in Kansas City is worth eleven cents in Liverpool, and one of the live questions now among all those interested in stock raising is whether they cannot secure a portion of the difference between four and eleven, by shipping via the gulf ports.

Look Ahead. It is estimated that within three years, possibly within two, there will be a million bearing orange trees in the Riverside, and two-thirds as many in the Redlands orchards. This is but one-third the total in Southern California, and as the average product is fully two boxes to the tree, this will mean ten million boxes, or more than 30,000 cars of this fruit to be marketed. The marketing period is from December 1 to June 1, six months, and it will involve the shipment of five thousand cars a month during that time. It follows that the present market area must be greatly widened, or that the consumption in the districts already covered must be greatly increased. Such increase is only possible by a lowering of the price to consumers, and as the growers cannot well accept much lower than the usual price, the improvement must come through the cheapening of the transportation or packing and selling charges. There is none too much time to prepare for it.

Delayed Emigration. It has been the general rule that after a period of commercial and financial depression there has been a pronounced movement of the people to the newer States. That movement, which has been long expected, does not ap-

pear to materialize, perhaps because we have not reached the turning point. The depression seems to be still on hand. Those who are willing and ready to move, can't, for the lack of means to move with. They cannot sell present holdings.

Nebraska Enterprise. The Nebraska Club is organizing a Home Newspaper Correspondence Bureau and solicits a thousand writers throughout the State who will send at least one letter a month to their "old-home" papers in the East. Outline letters will be furnished by the club so that there is little work required, except to fill in the blank spaces and add a few items of local news—to pull the wool over the eyes of the editor. They modestly expect to reach five million eastern readers and to advertise the attractive features of the State at a nominal cost. Nebraska people may lack in some things; evidently assurance is not one of them.

Lifting Mortgages. The farmers of Lincoln county, Washington found themselves under a load of mortgages which they could not lift from the product of their farms. They quit the farms and went prospecting in the mountains, found mineral, opened and worked the prospects, made mines of them and paid off the indebtedness due on the lands. They are fortunate in living in proximity to gold mines where such a course is practicable, but it is a suggestion of intimate relation which will sometimes exist between the agricultural and mining industries of the mountain States. If the mines had been developed by others it would have made a market for the products of the farm, so that each would have performed his legitimate share, the miner and the farmer.

Wisconsin Institutes. J. L. Shawver writes to the Grange Bulletin a very interesting communication with reference to the growth and success of institute work in the Badger State. There were one hundred and five institutes held there during the past year, all under the superintendence of Hon. George McKerrow and conducted by an able corps of five conductors, with assistants, two or three specialists and volunteer local talent. The influence is plainly apparent in improved culture, and farmers everywhere are taking the lively interest which indicates better than anything the real value to them.

MACHINERY AND APPLIANCES

THE CONTRACTOR'S DUMP WAGON.

The Contractor's Dump Wagon, recently put on the market by the F. C. Austin Manufacturing Company of Chicago, and illustrated above, is something that contractors will appreciate, and the reputation of the manufacturers is a guarantee that the wagon will be well made.

A serious difficulty with all "bottom-dump" dump wagons previously constructed has been that the doors being hinged, and therefore laterally rigid, frequently stall the team on the dump. When it is understood that all dumps, whether of earth, rock or garbage, are very uneven, and that one or more of the wheels, when the load is being dumped, rests in a pocket or low place, the objection to the hinge doors will be apparent; for example, should the hinge door strike a load previously dumped, or any obstruction before the load is fully discharged, it is necessary to move in some other direction to release the door, which, as will be understood, cannot be done without heavy pulling and a strain on the team; again, with one of the front wheels in a low place, the front end of the hinge door is likely to run into a previously dumped load or obstruction, which stops the team, as well as wrenches the box, tearing off the hinge door.

The doors of the Contractor's Dump Wagon, illustrated above, when closed, make a comparatively tight bottom; when open, they can oscillate in any direction, thereby adjusting themselves to the debris or obstruction underneath.

INCREASING USE OF WINDMILLS.

The fact that an Aermotor has just been purchased by the authorities of Garden City, Kansas, where all styles and varieties of windmills are in operation, goes to show that they consider the Aermotor the best manufactured, and fully able to stand the severe work required in raising water for irrigation. For this purpose a strong well-built mill is needed, as the work is very heavy, much more so than any task to which the windmill has heretofore been harnessed, and the past few years have demonstrated that the Aermotor is able to meet the requirements. It is increasing in popularity constantly, and in spite of the prevailing hard times, new factories and a larger force of workmen are needed to meet the demand. Arrangements are now being made to add another six-story building to the plant.

The Aermotor Company of Chicago is fully alive to the importance of irrigation, and has issued a special catalogue on this subject, which will be mailed to any address free, provided **THE IRRIGATION AGE** is mentioned when writing for it.

A USEFUL INSTRUMENT.

The Jackson Grade Level Company has recently made a very important improvement in their level by adding a horizontal circle, which is attached permanently to the shoulder of the tripod head. This is graduated into degrees, and a pointer is attached to the level above, thus enabling any one to run accurate lines straight or at any angle without the trouble of measurements.

Supt. W. F. Cash, of the Experiment Station, Idaho Falls, writes of this level as follows: "I have an instrument with which I can turn off a right or other angle, and find it very convenient in laying out irrigating ditches, where a series of small ditches take off from the main ditch. It is also very handy for laying off land for plowing, setting fences, etc. The new improvement adds greatly to the usefulness of the level, especially in an irrigated country."

A catalogue, with full description, will be sent free if you mention the Agz, upon application to the Jackson Grade Level Company, Jackson, Mich.

CULTIVATORS FOR IRRIGATED GROUND.

The cultivator to follow irrigation should be different from that which is used as a mere weed-cutter. It should stir and pulverize, rather than turn over. It wants many teeth, and should be easily adjustable, so as to run deep or shallow in an instant. It should also turn easily, and not be liable to scratch trees in turning or in careless work. With such a cultivator, one will cultivate more often than with any other, without hurting roots or turning up moisture to be dried out. The Killefer Cultivator, made at Los Angeles, Cal., is especially made to meet these requirements, and being all of iron can be left in the field the year round.

HYDRAULIC RAMS.

There are a great number of places throughout the West where the streams have a fall within a short distance, ranging from six feet upward, and whenever the conditions are suitable a Rife hydraulic ram is the cheapest method of raising the water for irrigation. The great saving is in the fact that the ram requires practically no attention after once being placed in position. This ram is made in sizes varying in capacity from 5 gallons a minute (for household purposes) to 150,000 gallons a day for irrigation. It is fully described in a little pamphlet, which, if you mention THE AGZ, will be sent free by the Rife Engine Company, 126 Liberty street, New York City.

HE WORKED.

Mrs. Farmer—"You said if I gave you a breakfast you'd put in an hour's work on that woodpile, and you've done nothing."

Hungry Hoke (deeply injured).—"Nothin', mum? I've bin a-calkerlatin' how many horse-power it 'ud require ter saw dat hull pile, countin' 200 teet' ter de saw an' each toot' wid a muscular resistance uv one chawergramme. Mebbe yer don't know it, but brain work's de hardes' kind uv work, lady."—Judge.

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"	15	$1\frac{1}{4}$	$\frac{3}{4}$	6 " 12	5	8	150	55 00	70 00
"	20	2	1	8 " 16	7	11	200	60 00	75 00
"	25	$2\frac{1}{2}$	1	10 " 24	11	2	225	66 00	81 00
"	30	3	$1\frac{1}{4}$	18 " 35	15	2	250	75 00	90 00
"	40	4	2	35 " 75	30	2	550	120 00	140 00
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THE IRRIGATION AGE.

VOL. X.

CHICAGO, AUGUST, 1896.

NO. 2.

THE PROGRESS OF WESTERN AMERICA.

Halting Industry. Whatever the conditions in other sections of the country, and no one will pretend that they are satisfactory anywhere between the Atlantic and Pacific coasts, there is no disputing the fact that the growth of irrigation in the western half as a prominent industry, which was so rapid from 1887 to 1892, has been materially checked and in many instances disastrously so. Before the close of 1892 capital had begun to flow freely in this direction, where it gave promise of exceptional returns for investment. Since that time not only have no new investments been undertaken, but many of the greater works which were unfinished have been left in such a state as to involve heavy loss and to preclude any possible profit from the amounts already expended. The causes for this are not all direct; indeed it can hardly be claimed that any of them are direct, for not only does the industry fulfill as to all finished works all that has been promised for it, but it is more than holding its own, relatively speaking, with every other productive industry of the country. While it assists and increases the products of agriculture and horticulture it shares with all other industries the loss from low prices and the depression incident.

Migration Suspended. However complete the facilities that have been or may be provided for the irrigation of lands, they are of no more value than before, until they are occupied and put in cultivation, and for the large plants where immense areas are furnished with a water supply the first essential is a prompt occupancy of the lands to be reclaimed. The

investment contemplates the utilization of every acre and can hardly be profitable without it. Charges must be fixed upon that basis and until such time as full settlement is effected the works, save under very exceptional conditions, must be run at a loss to the investors. While there is some movement toward cheap lands by people who have no present property holdings and who are therefore footloose and independent, it is not of a class such as is imperatively necessary for the improvement of irrigated lands. A man must have some capital, even though it be only a few hundred dollars, for he has to deal from the outset with comparatively high-priced lands and he must not permit any of his lands to lie idle, as all are necessarily subject to the maintenance charges of the canal system. This class of men, almost universally have investments, either in homes, lands, stock and personal property which must be turned into money before they can leave their present location. In no part of the country is it now possible to dispose of such holdings without sacrificing a considerable part of the original cost, and the practical difficulties are so great as to prevent many transfers.

Causes of Depression. These are variously attributed and very complex. If there was no difficulty in diagnosing the case it would be an easy matter to find a remedy. There can be no such effect without a cause, nor can it be so widespread and universal without a deeply-seated, underlying reason that is not temporary in its operations and influence. It is an insidious, cancerous growth, difficult to understand or to account for satisfac-

torily. The entire country is suffering and almost all classes of people, and that suffering is becoming so intense that it has become the paramount public question, demanding the attention of the governmental administrations, both national and state. Old party lines are being obliterated and new ones are being formed in the effort to solve the great problem and to restore the national prosperity. One of the two great parties has declared in its platform that the tariff is accountable for it all, while the other attributes the steadily augmenting troubles to the demonetization of silver. There are many dissenters in both of the parties, but so generally has the latter belief been promulgated, that the republicans, who were a few months ago confident of an easy victory in the coming elections, are now compelled to strain every nerve and utilize every resource of money and influence at their command to hold their own against the growing sentiment. All of the minor party organizations, representing the dissatisfaction with some present political conditions, prohibitionists, silver nationalists, populists, or a majority of each, are joining with the democrats to bring about a restoration of silver coinage, and the contest promises to be one of great bitterness and intensity.

Paramount Necessity. THE IRRIGATION AGE has confined itself rigidly in the past to the promotion of the single interest which it so distinctively represents, but now an economic question which directly involves the future of this industry has become a leading political question of such magnitude as to compel new party alignments and upon its proper solution a very great deal will depend. Its readers cannot fail to be interested, for it is distinctively the concern of the agricultural and laboring classes, who are the greatest sufferers from the present conditions. It is essentially a question where self interest, selfishness if you will, will be a controlling factor. Those who are favored under existing systems will strive to maintain their advantage regardless of philanthropic considerations. All business is largely conducted on the basis of self interest, and who fails to recognize it can hardly expect to succeed in his undertakings. We expect the banker to look

after his own interest, and he must recognize the right of the farmer to do the same. Where there is conflict as between the several classes, republican government contemplates the protection of the weaker elements with justice to all, and public sentiment as well as public necessity finds expression through the ballot box in the selection of representatives pledged to carry out in the legislative halls certain defined policies.

Political Situation. The discussion in these columns will be with reference to principles rather than candidates. The nominees are both strong men; both are clean men morally and intellectually; both are of Scotch-Irish descent, and are singularly alike in many traits of character; both are intensely earnest men and sincere in their devotion to the principles they enunciate; both are eloquent, and both are indebted to that eloquence for the prominence they have now attained; both are of a domestic nature, and both are happily mated with true and helpful wives; both are patriots and commoners, having close touch with the masses; both are men of experienced judgment, although one is much younger than the other; both have a congressional experience, and both were recognized for their ability as legislators; both are broad-minded western men, and recognize that nation with a capital N; either will uphold the honor attaching to the presidency of the greatest republic on earth. It is, therefore, a question of economic principles which the people are to pass upon, and there is every indication that the campaign is to be distinctively an educational one with every voter a seeker after the truth. The platform and the printing-press, the schoolhouse and the street corner will all have a part in the discussion which is about to begin. Business will have to wait upon the exigencies of politics.

Tariff Secondary. The first public appreciation of the depressing influences which were gathering head so quickly followed the last change in administration, it is no wonder it created confusion in the minds of the people. The tariff had been the issue on which the campaign had been fought, and the free traders had won. No matter what the

SENATOR FRANCIS E. WARREN,
of Wyoming, Chairman Arid Lands Committee, U. S.
Senate.

real cause, the winning party was naturally held responsible for the results which so promptly followed. Yet it is the plain truth that the free trade policy was never put in operation, except as to a few articles, and that the substitute legislation for the McKinley bill provided for a tariff quite as high and equally protective as to many important industries. The public clamor has been so loud that even the democrats themselves have tired of it, and while the republicans have sought to make capital out of the question they have been careful to assert that only such changes will be made, in event of their success in the coming election, as may be necessary to provide for a sufficient revenue to meet the requirements of the government. There is only the difference as between tweedledum and tweedledee in the two platforms this year. The republicans demand a protective tariff to produce sufficient revenue; the democrats favor a tariff that will provide sufficient revenue and that will incidentally afford an equal protection to all industries. They are willing to drop the subject and say no more about it, for every intelligent man is fairly convinced that free trade is not best for this nation under existing conditions.

Silver Coinage. Financial questions came to the front before the president-elect could take his seat, and the first notable act of President Cleveland was the calling of a special session to consider the repeal of the Sherman silver coinage law. It was asserted and insisted that only that was necessary to turn the tide of disaster. But the tide did not turn, and is still at ebb. Industry is half paralyzed; the common people are living on past accumulations, and are compelled to a practice of economy that is a hardship to an American of any degree; great crops are almost valueless to the producers, the income from them being barely sufficient to support life and affording no margin for expenditures which had made this the greatest home market ever known. The payment of old debts has been suspended, and even the current obligations can not be met. It is said that the implement dealers alone are carrying more than sixty millions of past due paper. There is no intent to repudiate or avoid its payment, but the crops they raise will not bring them money enough to pay it with. Constituting about one-half the population of our country, such a condition for our farmers cannot fail to have a blighting effect on dependent industries. Right here is where the trouble begins. The farmer cannot prosper with wheat at 35 cents a bushel, oats at 5 to 10 cents, potatoes at 10 to 20 cents, and everything else in proportion. He can live with but little in addition to his own products, but he can neither enjoy the comforts and luxuries to which he has become accustomed, nor can he accumulate property.

Cause of Low Prices. Reference is here made particularly to the prices of farm products. Let us see how they are fixed and where. Western Europe and Great Britain is the chief consuming market for food supplies and raw materials. Manufacturing in all its branches is the most important industry, employing most labor and capital. Their agricultural productions, though large in the aggregate, do not supply the home markets. Here, then, is the dumping ground of the surplus products of all other countries. That country which can sell the cheapest sets the price at which all others must sell of any particular commodity.

To illustrate, we will take wheat, which is a production common to many countries. Naturally Great Britain will favor its own colonies, and the commercial and financial supremacy of that kingdom gives it a commanding influence as to all its neighbor markets. When silver was demonetized twenty-three years ago, the chief competitor to the United States in supplying Europe with wheat was India, and a bushel of wheat was about equivalent in value to an ounce of silver. These two countries have continued to compete in the same markets, but under distinctly different conditions. They were on a silver basis then and they are yet; that is, their products were and are measured by a silver standard. This country had a bimetallic standard then and silver and gold were at a practical parity, and as there was free coinage of both metals the commercial and coinage ratio were the same. Through some influence which it is difficult to exactly locate our congress was induced to demonetize silver, to make a commodity of silver bullion, which being denied coinage fell rapidly in price relative to gold which became practically the single standard.

Coincident Decline. It was then that trouble began for us. It was not realized until we had begun to prepare for a resumption of specie payments, and then the fall in price was interrupted and retarded by the Bland-Allison act, which provided for the purchase and coinage of \$2,000,000 to \$4,000,000 of silver bullion monthly. There was a sufficient excess over the purchase limit, as fixed in that law, to meet all the requirements of Europe in keeping up the waste of its coin in circulation, and to settle Asiatic balances, and the price was pretty well sustained for a number of years, but at a discount of 20 to 30 per cent. Then the production of silver began to increase in this country and the surplus for export was greater. With mints of all the leading nations closed against it, with all the financial institutions of Europe and this country leagued in opposition to its free circulation, and with the ruling of our own treasury officials to still further discredit it, the price began to fall again. Then came the Sherman bill to interpose another check by fixing the limit of purchase a peg higher, and providing for the

purchase of \$4,500,000 each month; but the production went on increasing. The British government suspended free coinage in the India mints, and the price went down lower than ever. Now, it is a striking coincidence that the price of wheat fell and rose just in proportion with the rise and fall in the price of silver—that is, in this country. It did not rise or fall in India. All the time the price has remained steady there, and the ounce of silver has purchased a bushel of wheat.

Disastrous Effects.

Let us consider the effect on this market. When silver bullion was worth \$1.32 an ounce, as it was in 1872, it made the bushel of India wheat cost in Liverpool about \$1.45. Wheat from this country was worth then the Liverpool price less transportation, or about \$1.15 in Chicago. When they can buy our silver in London at 66 cents—and it was down to 63½ in 1894—the bushel of wheat can be bought in India, and in other silver countries, on the same basis as formerly, but at a cost when measured in gold of only just one-half as much and it can be landed in Liverpool at about 85 cents, it follows that we must accept for our wheat the Liverpool price, as before, less the cost of transportation. We are holding our coined silver on a parity with gold, while we are selling our bullion silver as a commodity at half price. The illustration as to wheat is equally applicable as to all those commodities which can be bought on a silver basis, in silver using countries, that are sold in the gold using markets of Europe in competition with ours. The lowest price from any country sets the price for all, and our misfortune is aggravated from the fact that the Liverpool price for our surplus also fixes the price for what we use at home. If we figure it out as to wheat we shall find that the effect upon the wheat crop of last year—467,000,000 bushels—would show a loss to our farmers and transportation companies, the greater part borne by the former, of at least \$280,000,000, although less than one-third of the crop was sent abroad. All the food products, wheat and flour, corn and oats, provisions in every form, and everything which enters into the production of them is affected in almost the same proportion.

restoring the value of silver bullion, or that they will aid us in doing it? It is hardly creditable to the intelligence of the American people that they should submit so long as they have to a controlling influence in our legislation which means so much of hardship and suffering for the great mass of the people. THE IRRIGATION AGE will discuss the silver question along the lines herein indicated during the coming campaign, and fully believes that this country cannot hope for recovery from the present depression until it provides for the coinage of all silver that may be offered at the mint at the existing ratio. It would be infinitely better that every ounce of silver bullion should be sunk to the bottom of the sea than that it be permitted to go abroad under existing conditions with the effect to depreciate the value almost one-half of all our products.

JAMES H. MCCLINTOCK,
of Arizona, Member National Executive Committee and
Local Committee on Publicity.

Extent of our Loss. On all these taken together, and on cotton, the price of which has been similarly affected, although it is impossible to give exact figures, the aggregate loss cannot be less than \$400,000,000 on what we have exported, and four times as much on our total production. The total loss on silver itself is not to exceed \$30,000,000, and yet we are told there is nobody interested in, or to be benefited by, the silver legislation but the silver mine-owners. If the gold bugs can make the farmers of the country believe that, they may well be justified in their opinion, so often suggested, that the farmers are a brainless set, incapable of thinking or acting for themselves.

Opposing Interests. All of the gold standard countries except our own are among those classed as consuming countries. They have not hesitated to almost destroy their own agricultural industries—for they are suffering in common with ours, because in their case, as before stated, the manufacturing and commercial interests are paramount. As buyers of such products if they can save \$400,000,000 on the share purchased from us and proportionally on the vastly greater quantities purchased elsewhere, is it reasonable to suppose they will invite us to join them in

Mexican Progress. A few years back Mexico began to gain ground with its industries and to prosper as the result of a more stable government. At first it began buying more largely from abroad, and for a while it looked as though the western cities would have a profitable market for many of its manufactured products. Being on a silver standard, and producing its own money metal—all it can use at home and a considerable amount for export—as gold has appreciated in other countries it has carried the prices of such goods as were imported to almost double the former price. Its enterprising capitalists have been quick to appreciate the great advantage it is giving them to introduce home manufactures in pretty much all lines. They have been buying machinery in this and other countries where stagnant business conditions have been reducing prices, have erected factories, have employed instructors for their home employes and are reaping great profits, as well as affecting great savings to the consumers, by manufacturing cottons, woollens and other textile fabrics, foundry products and machinery for their mines. More than that they are introducing American cattle and hogs for breeding purposes, with a view to the home production of meats and provisions. It is undoubtedly good for Mexico, but it is cutting off a very profitable portion of our western trade.

The Congress, Dec. 15 to 17. The work now being done in behalf of the Fifth National Irrigation Congress, to be held in Phoenix, Arizona, December 15 to 17, inclusive, promises, as far as attendance and entertainment go, to result in one of the most successful meetings yet held. The members of the local committee at Phoenix are men of business ability, integrity and enterprise. They are fully alive to the value of holding an irrigation congress in the Salt River valley, where the reclamation of the desert has reached an advanced stage, and they are ready to demonstrate to the outside world what can be and what has been accomplished with the use of water. Preparations for the comfort and entertainment of the delegates and visitors are already being made, and no one need fear attending for lack of accommodation, which will be ample.

What Will the Congress Do? The work before the congress is, in a measure, outlined in the autograph letters from leading western men, which appear elsewhere in this issue, but it is yet too early to predict what will be the outcome. There seems to be no pronounced sentiment in favor of any particular legislation. Matters are in a chaotic condition awaiting the coming of men of brains to lead them from the wilderness. In a recent letter the chairman of the executive committee said, "The general opinion of the committee is to have some legislation done at the next Congress," but further than this apparently nothing has been decided. It is to be regretted that the national executive committee, upon which devolves the responsibility, is not composed of men thoroughly familiar with the necessities of irrigation and the West. The placing of men upon this committee merely because they are residents of states which *ought* to be represented, irrespective of qualifications, and whether they are drummers for whisky houses or practical irrigators, or totally unfit from a moral standpoint, or other reasons, to lend dignity to the most important cause before the American people, has resulted, in a measure, in giving the public a wrong impression regarding the movement. Individual effort alone is responsible for the extension of the irrigation idea during the present year, and too much cannot be said in praise of those few

who have earnestly and faithfully labored for the general good.

The Northwest Overlooked. The great Northwest, one of the richest and most fertile regions on the globe, and where irrigation is being extensively practiced and advocated, has been passed in silence. Six large and important states—Washington, Oregon, Montana, Wyoming, North Dakota and South Dakota, are not even represented on the national committee. This condition of affairs causes thinking men to fear the future. No organization which omits from its councils over one-third of the area which it purports to represent can be truly termed national. No determined efforts have been made with a view to inducing the Northwest to resume its proper place in the movement, and yet it is noteworthy that the great bulk of the work in favor of irrigation in the last session of the United States Congress was borne by the men of the Northwest. What was accomplished is related by Senator Francis E. Warren of Wyoming, on another page.

The time is at hand for the irrigation movement to push forward, but it can do so only when it stands on a broad, comprehensive and intelligent basis, recognizing no state or section in preference to others; recognizing the fundamental principles upon which the reclamation of the arid lands are based, and straining every nerve to reach the desired end, not with a view to making or unmaking the reputation of one man or a set of men, but with an eye single to the main purpose—homes and prosperity.

Government Publications. The Indiana Farmer is advocating that agricultural reports of the government shall be so distributed as to be made accessible to farmers generally. In reply to its suggestion Assistant Secretary Dabney favors the idea and gives some information of public interest. The edition of the agricultural report annually is now 500,000 copies, published and circulated at a cost of \$400,000. Of these 470,000 copies are distributed through the senators and representatives, 1222 and 1000 each respectively. There are 4,500,000 farmers in the country so that only one-ninth could be supplied if all were legitimately used. He suggests that they might be sent, as

The indicated crop of corn in this country is 2,154,600,000 bushels, as against 2,151,188,580 last year.

The indicated crop of wheat is 434,776,000 bushels, as against 467,102,947.

There is certainly nothing to give encouragement for better prices—extra large crops here with much of the old crop still unsold, and a limited export demand. The farmers are not in position to be over-jubilant with this outlook.

Water Development. The necessity for water supply in many portions of Southern California is leading to many remarkable developments as to underground currents. The Vineland Irrigation district, some two years ago tunneled under the river and got a fine supply of water for awhile. But the Azusa and Duarte people had a tunnel above them some 2,000 feet into the mountains and another diverting tunnel below. They built a flume between the two which left the bed of the stream dry, and cut off the developed (?) water of the Vineland district. The latter went into the courts about it but did not cease to dig for water while the suit was pending. They sunk a shaft from the bottom of their tunnel and

W. L. PARK,

of North Platte, President Nebraska Irrigation Fair Association.

well as other public documents to the postmasters, but admits that it might be a question whether they would be willing to undertake such a work unless it were made obligatory. Would it not be altogether preferable that they should be sent to the trustees of each public school district, and form the nucleus of a valuable library that might be accumulated in time. It could then be made a part of the teacher's duty to take care of and keep track of them if they should be permitted circulation outside the school-room. They are valuable publications and are becoming more so every year as the experimental stations in all parts of the country furnish the most reliable data as a basis for public discussion.

Low Prices The government reports to a *Certainty*. July 1st indicate a very high average for the corn, wheat and cotton crops of this country and an average is indicated of European grain crops in the United Kingdom, Belgium, Russia, Germany, and Spain, and above an average in Austria, Bulgaria, France and Roumania. The French wheat crop is likely to meet home requirements for consumption.

E. F. SEEBERGER,

of North Platte, Secretary Nebraska Irrigation Fair Association.

have struck a flow of water which enables them to pump 100 miners' inches day and night into the tunnel. In the bed of the same river, the San Gabriel, a few miles below, the Killian well is yielding 350 inches constantly. The value of water in that locality is so high that it justifies large expenditures to find it and to carry it without waste after it is found.

Past Due It is said that manufacturers,

Paper. jobbers and dealers in agricultural implements hold as much as \$60,000,000 worth of past due notes from farmers who are unable to pay. The farmers have been put in this condition financially by the steadily falling prices of their products during the past few years and it is difficult to see where relief is to come from, and how this vast sum can be finally paid, if similar conditions are to prevail for all time. It is not only the holder of the paper who is walking the floor in anxiety and distress, for his business honor is not generally more dear to him than to the farmer, who only delays payment through sheer inability. And while the half of the consuming population of the country is so much involved and therefore unable to buy only absolute necessities, it is not reasonable to suppose the country can have a revival of prosperity. It has set the farmers thinking and their thoughts are likely to have expression in their votes at the coming presidential election.

The Field It is encouraging to note the **Widening.** experimenting that is in progress all over the country, even in what is known as the rainfall area, to test the practical value of irrigation. The New Hampshire station has been trying it on the farm and garden crops, and with very excellent results. It is used there as supplementary, and to tide over the season of drouth. To have a sufficient water supply available for transplanting and for forcing special crops in the garden is a great advantage at any time. To have it ready for use, if it be needed for only a week or two, to prevent a crop suffering from drouth, whether in the garden or field, will justify a considerable expenditure.

A Wise Decision. The board of regents of the State University of California have decided to arrange for the holding of

meetings in various parts of the state, so as to bring out the opinions of farmers in regard to matters for their interest, which the university seeks to promote. Fifty meetings are to be held as soon as practicable. It cannot fail to awaken an active interest on the part of the whole people in the work of a university which has been admirably managed for years, and which has ever accomplished effective work in behalf of all the material interests of the state. It is a practical blending of theory and practice, a co-operation between the educated thinker and the skilled farmer, a direct alliance between field and laboratory.

For Small The Implement Age calls **Remittances.** attention to a business necessity which everyone having to make or receive small remittances will immediately recognize. Some kind of paper money—why shall it not be silver certificates? to represent the fractional coins as well as the full dollars?—that can be used for the remittance of small sums, without the trouble and expense of securing money orders and of collecting them, would be a very great convenience. The risk involved in the use of them is hardly worth considering as an actual fact, surely they are safer than the remittance of coins can be, and for a dollar or two the trouble in getting a duplicate money order or in tracing a lost one, is worth more than the amount involved.

DR. W. L. WOODRUFF,
of Phoenix, Arizona.

Fruit Shipments. Last year there were over fifty expedite fruit trains over the Union Pacific road from California, and it is expected that the number this year will be greatly exceeded. Last year it was proved by experiment to be entirely practicable to ship fruit by the train load to New York and thence by steamer to the European markets. It arrived in good condition and brought good prices. The first train of the season came through Chicago about the 12th of July, and included thirteen cars of green fruit and ten cars of tea, all billed to London. It is to be followed promptly by others, and California fruit is becoming as well known in London and Liverpool as in our own eastern states.

Steamships to Galveston. It was said that the great steamship companies would not recognize the Galveston port, no matter what the depth of water. The great North German Lloyd Steamship Company has seen its interest in arranging to establish a line of first-class ships between Bremen and Galveston which will soon be in regular operation. The rate for passengers and freight is but slightly more than from New York. One effect of the deep water harbors on the Gulf coast has been a reduction of six cents per hundred in the grain rate from Kansas to New York, and this is only a beginning. The Harrison line of passenger steamers is also to run regularly between Liverpool and Galveston.

WHAT THE NEXT CONGRESS SHOULD DO.

PUBLIC EXPRESSIONS FROM LEADING WESTERN MEN.

I AM pleased to note the very apparent interest that is being taken by THE IRRIGATION AGE in the coming session at Phoenix of the National Irrigation Congress, and will give you my opinion of the work that should especially come before the body.

At the risk of being considered decidedly rude, the first proposition I would advance is that the Congress should be made very unlike that excellent and valuable convocation usually known as a "farmers' institute." Of course the proper irrigation and cultivation of "goober peas" is an interesting topic (in its place), but its place is not in a national congress called for the advancement of the interests of the arid west. An able authority at Albuquerque put in an hour or two telling how to irrigate apricot and peach trees on uneven ground, but I doubt if his argument would have had much force before the senate committee on irrigation of arid lands. Another learned gentleman last year spent two hours in reading a paper on the influence of climatic changes on crops, but few there were who stayed to hear him.

From these I make the assertions: The coming congress to be a success must first be made interesting to its participants, and the work, considering agriculture and irrigation broadly and abstractly, must be confined to such matters as will advance through capital, through co-operation and through legislation the reclamation of arid and semi-arid America.

The Irrigation Congress should be rather a legislative body, an advisory committee we may say, to Congress and to the state legislatures. Its resolutions should be few and should be well digested and in them, if possible, should be embodied schemes for improvement rather than complaints against existing evils. Its work should be political in the broadest sense of the word "politics," and educational to the extent at least of showing the massed millions of eastern dwellers that upon the extension of agriculture in the west rests much of the nation's future

prosperity. Reclamation of the arid plains should, it is generally admitted, be under the auspices of the general government, for the greater portion of the lands to be reclaimed yet lie with title in Uncle Sam. The dollars needed can well be spared from the national treasury, yet the West will ask no more than to pay all costs as soon as water has been taken to the thirsty lands.

Matters of immigration are germane to the discussions, as are also the land laws affecting desert entries. Well to be touched upon also would be the hydrographic plats showing the points at which the storm waters of the West might best be impounded.

But no discussions on subsoil plowing, if you please; no sectional booming, no personal boasting, no personal animosities exhibited.

Add to all this, short, snappy addresses. Let the speeches be limited to fifteen minutes each, the balance to be printed if deemed worthy of printing. Then turn the wrangling over to special committees appointed from the floor, hold short sessions, and more will be done at the Phoenix Congress than at the other congresses combined.

I believe the Phoenix session is going to be a grand success. All signs, and there have been many signs of late, point that way. Phoenix has something of a reputation out West for entertainment, and all are to be assured that next December the reputation will at least be sustained. There will be plenty of room for all comers. About that time several thousand strangers are usually due to arrive, and quarters will be found with ease for double that number. We have a hundred-room hotel and a dozen or more of smaller hostels, and by fall the Adams Hotel, to cost \$150,000, will be complete. It alone will have accommodations for 600. Further, Phoenix is considered by the drummers, and they are the best judges anywhere, to have the best eating at the lowest price of any town on the coast. There will not be a raise of a

nickel because of the presence of the congress.

As to reception, it is really too early to promise anything. It is to be expected that the local club, which will have commodious quarters at the Adams Hotel, will throw its doors open. The local railroads will be utilized for free excursions to points of interest in the immediate vicinity, and I have in mind a trip to some mines, to be reached by the Santa Fe in a couple of hours' run. Carriages will be at hand to convey all without cost to the farms and irrigation plants of the Salt River Valley, and at least one evening will be given over to a general reception of visitors. On the return trip facilities will be offered for visits to Southern California, to the Grand Cañon and other points renowned. These features, when matured, will, of course, serve to attract the casual excursionist, who knows and cares little of irrigation, and who comes mainly to see this wonderful country when the fares are low.

As to fares, I have already started correspondence with representatives of the Santa Fe and Southern Pacific systems, both of which enter Phoenix, and am assured that a rate of a single fare for the round trip will probably be made by the Western Passenger Association from all points between the Pacific Ocean and the Mississippi. This should bring a crowd.

Our local committee of fifteen on arrangements is now at work getting out advertising matter to be distributed broadcast.

The time of the session will be fixed at a meeting of the executive committee, to be held at the Windsor Hotel, Denver, July 30 and 31. It will, without doubt, be for the middle of December. This time was indicated at Albuquerque and for a variety of reasons. The main one lay in the fact that campaign time must be avoided, and yet the convention must be held within the year.

December is a pleasant time in Phoenix. The temperature is just right. The only disadvantage is that no deciduous fruits are to be had, but oranges will be ripe, fine big Washington navels, and they will, in a measure, fill the gap. We have a roof-garden scheme for a couple of sessions, if the weather is as it usually is, and delegates may return to the ice-bound East telling of an open-air meeting in

December, flanked by flowers and palms, and warmed by naught else than the rays of a genial sun.

JAS. H. MCCLINTOCK,

Member Nat'l Executive Committee.

Phoenix, July 1, 1896.

AS the time approaches for the convening of the Fifth National Irrigation Congress at Phoenix, Arizona, those who have watched these conventions in the past, and others interested in irrigation development in the Western United States, are wondering whether any good results will flow from the coming meeting. Certain it is that there is room for the accomplishment of much that would materially aid the cause of irrigation. The question then becomes, in what direction can this congress do the most?

To the writer it has always seemed that the irrigation congress might exercise a powerful influence upon legislation, both state and national, but especially the former. That most of the western states have not at present what can be called enlightened systems of water laws is a fact to be regretted, and it would seem that the intelligent representatives of these states in the irrigation congress should address their efforts to the remedying of this condition before everything else.

There can be no question that good and efficient systems of irrigation laws, uniform in so far as the governing conditions will admit, in all of the irrigation states, are a prerequisite to the highest success in irrigation development and practice. Upon such laws depends the safety, I may even say the very existence, of the capital invested in irrigation enterprises and of the users of the water. This being true, and the national government having confirmed in the states the right to enact the necessary laws, surely the irrigation congress, if its members are sincerely in earnest in their desire to advance the cause they presumably represent, should first devote itself to securing the adoption by the respective states of the best possible systems of water laws.

Second in importance is the question of national legislation upon the subject, though it is one which should have grave consideration at the hands of the congress. The arid public lands and their disposition; the general study of the water re-

sources of the country; the question of international streams, of navigable rivers and lakes whose waters may be needed for irrigation, and according to some, the matter of interstate waters, not to speak of the forestry problem, and the vacant pasture lands, are all questions for whose solution we must call upon the national legislature.

While not at this time suggesting any solution to the various problems referred to, the writer desires to urge upon those who will go to the congress, and especially upon the men whose duty it will be to arrange the program of the meeting, that they will give these questions their very earnest consideration, for upon them devolves a great share of the responsibility of finding and suggesting to the law-making bodies their solution. It is also hoped that every member of the coming congress will fully realize that the questions it is summoned to consider are paramount to any considerations of *who shall preside over the convention, or where the next shall be held.*

L. H. TAYLOR,

Member National Committee, Nevada.
Reno, July, 1896.

FIRST, I want to see steps taken by that gathering of the friends of irrigation to lift the whole irrigation effort into truly national proportions. The states of the Mississippi valley, at least, should be induced to join actively with the present irrigation organization, and so to aid us in carrying forward the great movement for reclaiming our arid lands not only, but for introducing irrigation methods, as such are now plainly seen to be needed throughout the humid states.

A second object to be set afoot by the Phoenix meeting should be the immediate inauguration of an irrigation survey of arid America by the general government into natural irrigation districts, with local self-government in relation to irrigation, and the forest and pasturage administration lodged, by both national and state laws, in the hands of the farmers and actual dwellers in those districts. All efforts short of something of this kind must be lacking in coherence and system. The time has come for us to plan for unity. "Nature has divided the arid lands into districts which are usually undefined."

My expectation is to report good progress to the next congress from the tops of the

Alleghany mountains to the waters of the Pacific. Kansas will send a full delegation.

We have *agitated* for four years; it is now time to *realize*. We have talked and resolved, and this talk and our resolutions have drawn the attention of our brightest minds to a consideration of the valid claims of arid America for recognition by the whole people. Now, it is for us to show by our deeds that we are "up-to-date" in deed and in truth.

J. S. EMERY,

National Lecturer, Kansas.

Lawrence, July, 1896.

1. THAT I would not be in favor of repealing the present desert land laws unless they should be replaced at once with a more comprehensive and efficient law. The stability of the United States rests largely on the encouragement of the small land holder; those features of our present law which aid land-grabbing by large corporations should be eliminated.

2. I unhesitatingly and earnestly advocate immediate opening of every Indian reservation to settlement and the forcing of all Indians to sever their tribal relations and take land in severalty.

3. I see no reason in justice why the Carey laws should not be immediately extended to include the territories. If honestly carried out it would aid in increasing their population and hasten the time of their statehood.

4. I am not in favor of leasing government reservoir sites to private individuals or corporations, unless under very close restrictions which will protect the small land holder.

5. I believe in liberal appropriations by the national and state governments for surveys and investigation as to water supply suitable for irrigation and construction of storage reservoirs, and systems of main canals as well.

6. I believe that the amended form of the "Wright Law," passed by the last legislature of the State of Washington, was a fairly safe law, and in an honest community would be an attractive investment. In a dishonest community no law could prevent fraud or attempt at fraud. The principle of the amendments I refer to is that of supervision of transactions by county and state officials whose position would be such that they would not be

likely to have personal interests connected with the district under consideration, and whose public position would be much of a safeguard against their connivance with fraud.

ARTHUR GUNN,
Wenatchee, July, 1896. Washington.

WITH respect to the topics for consideration at the next congress, I would suggest:

1. A *resumé* of the work accomplished by the irrigation movement in the arid regions during the last four years. This could, I think, be best shown by the selection of representative localities and a contrast of their past with their present condition.

2. A thorough consideration and demolition of the fallacy that the irrigation movement tends to create an overproduction of the necessities of life. This subject should be so handled as to show not only the unreasonableness of the opposition in the east, but also its utter futility.

3. Careful organization to carry the irrigation movement into the humid and semi-humid states. Effort should be made to strengthen the hands of those working in those states. This I believe to be of the highest importance, as by this means we can favorably influence legislation for the arid region also.

4. Some fair and candid statement of the position of the irrigationists with re-

spect to the general commonweal. This higher plane should be insisted upon. Hitherto appeals have been largely made to individual selfishness, and but little attention (generally) given to the broader side of the movement.

5. Attention to the connection between the railroad system of this country and the irrigation movement (what the railroads have done, are doing and can do). This subject should be made a prominent one, and ought to be exhaustively and fairly considered.

6. Persistent assertion of the fact that all irrigation legislation must *follow* and not *precede* public sentiment. No initiatory step can be looked for from the government.

Without suggesting for a moment that the above paragraphs exhaust the list, I have outlined some of the points which, in my opinion, deserve consideration. We are now at the outset of our career, and this meeting will determine our *status* as an economic factor in the progress of this country.

Personally, I feel that this is where we now stand, and in order that the movement should enter upon the second stage of its existence fully equipped, I think that no pains should be spared to make the Phoenix meeting a success from the start.

THOMAS KNIGHT,
National Committeeman, Missouri.
Kansas City, July, 1896.

THE INFLUENCE OF IRRIGATION ON CLIMATE AND HEALTH.

BY W. LAWRENCE WOODRUFF M.D., PHOENIX, ARIZONA.

THE conclusive discussion of this subject implies a study of the physical conditions of the given locality—a comparison of meteorological data for a considerable period while arid conditions prevailed, with similar data after the same territory has been brought under irrigation—consideration of the percentage of humidity most conducive to health, with the prevailing temperatures, altitude and wind movements, and the determination of actual and ascertained general effects,

as shown by freedom from disease in the community and by vital statistics. Each of these elements of the problem must be studied in its relation to all the others. The inquiry is inherently difficult and complex under the most favorable conditions.

Captain William A. Glassford, Signal Corps, U. S. A., of Denver, Colorado, a high authority in such matters, says in a recent article: "In the hottest parts of this arid region the midsummer weather is not

only endurable, but even enjoyable and refreshing. These are the facts as they exist now, when the present conditions—the bare soil, etc.—are specially conducive to high temperatures. But it may be readily conceived that there will take place salubrious modifications, as some of us have already realized, when these desert places are covered with the green carpet of alfalfa and the verdure of trees; when the wasting waters are stored and diverted by the irrigator to the surface of a soil only waiting for water to produce bountifully, not only the fruits of the earth in due season, but almost to produce the seasons themselves at will."

In the nature of the case we could not expect any definite scientific data for this vicinity prior to the practice of irrigation. The precipitation is about seven inches per annum. Settlement and residence are impracticable in a locality in which agriculture must depend for moisture solely upon irrigation. In the Salt River Valley, settlement and irrigation came hand in hand.

The Salt River Valley, with Phoenix as its center, is situated in the vicinity of the 33d parallel of north latitude.

The surrounding physical and climatic conditions are totally different from those of any other locality under irrigation, and must be understood in order to arrive at right conclusions.

It has an elevation ranging from 1,000 to 1,500 feet above sea level.

High mountain ranges surround it on all sides, save on the southwest, where it verges into the larger Gila Valley.

The Gila Valley, under similar conditions, extends to the Gulf of California, which in turn extends with its 53,000 square miles of surface well into the tropical zone.

This great, inland sea, with its mouth 250 miles wide, flanked on either side with continuous mountain chains, acts as a funnel into which the tropical waters and winds sweeping from the equator up the Mexican coast, enter.

These surroundings and winds are largely the influences which go to produce our peculiar and phenomenal climatic conditions.

It is universally conceded that an atmosphere carrying too much moisture is unfavorable to perfect health. It may not be so well known, but is equally cer-

tain that the air may be too dry. A couple of my patients had this experience. During a long drive upon the desert, on an exceedingly hot day, the air became extremely dry and fairly burned. Their throats became parched and perspiration ceased. No amount of water taken internally seemed to relieve this condition, which was speedily followed by a languor and then stupor, bordering on coma. This thoroughly alarmed the wiser of them, and sensibly, during the remainder of the day they took turns, fifteen minutes in duration, one driving while the other gratified the irresistible desire to sleep, and in this way they reached irrigated ground in safety. The same phenomena have been observed in numerous other cases. I am satisfied this explains many cases of death upon the desert which have heretofore been attributed to lack of water. During the summer time, in this locality, elimination by the kidneys is reduced one-half. Perspiration is immensely increased and the skin becomes the chief eliminating organ of the system. When the percentage of humidity in the air gets below a certain point, evaporation from the surface of the body becomes too instant, the surface burns, perspiration and elimination of effete material ceases, thus producing the phenomena above described. I attribute these effects entirely to a lack of sufficient moisture in the atmosphere.

I am not prepared, as yet at least, to fix definitely the point at which the percentage of moisture in the air is neither too great or too little. Investigation may, and probably will, show that the most favorable degree of saturation would vary according to individual characteristics. It is probable there is a range of 10 or 12 degrees within which it is difficult, if not impossible, to say that any given point would be more favorable to general health than another. It may be safely said that in the temperature of the Salt River Valley, during the summer, a humidity below 8 per cent is disadvantageous, while that above 20 per cent begins to become oppressive.

Both actual and sensible temperature, as shown respectively by the readings of dry and wet bulb thermometers, must always be considered in connection with the humidity. In every climate there are seasons when the percentage of humidity is excessive, and results generally in a

feeling of depression. In the Salt River Valley these periods are usually limited to say a week in February and a week in August, very much less in duration than in any other locality within my observation. There is very little wind here. The mean average hourly movement at Phoenix for a period of years is stated by the United States Signal Service at 2 and 37-100 miles. It would be interesting to compare the humidity of the higher lands of the valley near the foothills with that in the lower valley, but no data exist for such statement. We know that it is 10 to 15 degrees warmer in winter and cooler in summer, for instance, on the lands under the Rio Verde Canal on the north side and the Highland Canal on the south side of the Salt River than near the river at Phoenix. The extremes of temperature between day and night are much less on the higher lands than in the lower valley, and the danger of taking cold is proportionately reduced.

It is probable that the effects of irrigation on climate and health under the high temperature and low relative humidity of this valley are somewhat different from those in regions of lower temperature, greater humidity and either higher or lower altitude.

It is almost impossible without accurate observations to make comparisons, or to arrive at safe, definite conclusions as to the influence of irrigation on climate, either in a general way or in a given locality. I have been unable to procure any data whatever as related to this valley, or to any similar locality, showing the relative humidity before and after irrigation. Without such facts I can only state conclusions arrived at from personal observation and study of its effects on this locality.

I am decidedly of the opinion that upon the deserts of Arizona, without irrigation, the moisture in the atmosphere is sometimes so little as to interfere with health and comfort, and produce feverish conditions. The evaporation of water from the irrigated land supplies this deficiency to the air and obviates the injurious tendency.

I have frequently had this experience. The "wetting down" of my well shaded porch on a hot summer day lowers the temperature, shown by the thermometer hanging upon the wall, 10 to 15 degrees.

This results from the refrigeration of the air in the process of evaporation of the water.

It is well known that a well shaded dwelling in the midst of an alfalfa field is much cooler than the same residence surrounded by bare ground. This is due in part, perhaps, to the absence of reflection from the earth, but chiefly I think to a similar slight refrigeration of the air by the evaporation of the moisture in the earth and vegetation of the surrounding field. The effect becomes still more marked when a gentle breeze is blowing.

At Phoenix, during the summer months, the air is so dry that the midday registration of relative humidity ranges from 6 to 15 per cent. It rarely goes above the latter point, and if it were not for irrigation it would drop still lower, which is not desirable.

My conclusion is that the evaporation of moisture from irrigated surfaces slightly increases the moisture in the air and promotes the healthfulness of both animal and plant life.

That the evaporation from irrigation has but slight influence in increasing the dampness in the surrounding air will be readily understood when we recall the following facts: That moist air is lighter in weight than is dry air. That moisture is evaporated as an invisible gas. That being lighter and a gas it is not a disturbing atmospheric element. That it instantly rises with great velocity to a point in the atmosphere where the temperature is below its own dew point, where it becomes visible in the form of clouds. But a very small portion of the evaporated moisture is retained in the lower and warmer strata of air. The hotter the air the greater is the evaporation from the irrigated ground. This evaporation lowers the earth's temperature and also that of the surrounding air.

During the winter months the temperature ranges much lower, evaporation is much less and the air is constantly so dry that the slight influence it exerts is scarcely noticeable. During the last winter the mean relative humidity was as follows: 1895, Oct. 53%, Nov. 68%, Dec. 58%; 1896, Jan. 54%, Feb. 45%, Mar. 38%, Apr. 32%, with a rainfall during these same months of but 2.70 inches.

It is well known that the best qualities of citrus fruits can only be grown where

there is sometimes danger from frost. This danger in the citrus localities of the Salt River Valley only exists for say an hour at a time, and that about sunrise of a frosty morning. The horticulturist is able by flooding his irrigation ditches with water at this time, to obviate, or lessen, the danger to his fruit. The water in the ditches will freeze before the fruit or the tree and thus the temperature of the surrounding air is raised. This phenomenon exists all over the district under irrigation, to a greater or less extent, and the extremes of day and night temperatures are thus modified.

As to the influence of irrigation on the healthfulness of the inhabitants of an irrigated district I can be more positive. It is demonstrated by actual experience to be advantageous. Phoenix and the Salt River Valley is the healthiest place in the United States. Next to it comes Salt Lake City, Utah, also in an irrigated district.

That part of the Salt River Valley north of the Salt River, west of the Verde, and east of the Agua Fria, covering a territory of 250 square miles and including the City of Phoenix, of which the population on a conservative basis for 1895 is placed at 15,000, had for the year named an annual death rate of 5.04 per one thousand inhabitants. Salt Lake City during the corresponding year had a death rate of 7.37. Our death rate for the five summer months last year was but $\frac{1}{2}$ of one per cent. of our population, or 2.54 for one thousand inhabitants in the above named territory. With this showing no one for an instant can imagine that in the least does irrigation militate against health.

On the other hand I believe that irrigation is a major factor in increasing the healthfulness of a community. It is probable that on account of our favorable climatic conditions this is more emphatically true of the Salt River Valley than any other locality. I refer this fact chiefly to three causes.

Under an irrigation system properly operated there are no water holes, or sloughs in which vegetation grows only to decompose and pollute the air. There are no pools of stagnant water to create miasma. The water supply is under man's control, both as to volume and times of distribution. Vegetation is rank and prolific, but grows only where it is desired, and is limited to valuable products. Useless vegetation is discouraged, but should it by chance exist, it rather dries up than rots.

This low death rate is further explained by the constant living in the open air, which we enjoy to its utmost limit.

Irrigation by promoting the rapid and phenomenal growth of trees and the verdant grass which carpets our lawns makes a continuous existence out of doors possible and enjoyable for three-quarters of the year.

We live nature's life as nature intended we should live it, and have our reward of unparalleled healthfulness.

I do not believe there is any other place on earth where children are so universally healthy. This is especially true of the summer season. They are marvelously free from "summer complaint" and kindred ailments. I never saw any place where the children thrive as they do in the Salt River Valley.

To quote Capt. Glassford again, he says in the same article: "This greater portion of Arid America, elevated high above the humid levels of the east, covered with aspects most sublime of the earth, fed with the most invigorating constituents of the atmosphere, will yet be appreciated; and these elements, under the influence of modern civilization, will produce the hardiest and grandest race of men and women who have yet trod the planet. They will create a Western empire and become masters of the continent, if not of the world."

THE SOUTH DAKOTA ARTESIAN BASIN.

A GEOLOGICAL STUDY.

BY FRED F. B. COFFIN.

THREE conditions must be present to make any country a desirable place to live: a good climate, a fertile soil and an abundance of pure and wholesome water.

That South Dakota possesses the first two conditions in an eminent degree is past controversy. It is the purpose of this article to demonstrate from known facts that the third condition exists here in quantity, in permanency and in purity second to no State in the Union. As a further preliminary I will state that it is utterly impossible to treat this subject in its entirety in an article designed for the public press, hence, only the salient features will be presented.

South Dakota lies at the foot of one of the largest catch basins in the United States, being no less than the upper Missouri Valley. The drainage area of this valley from Sioux City, Iowa, northward is 314,900 square miles. All the drainage of this vast area, with slight exceptions, surface and phreatic, must pass through South Dakota on its escape seaward. This vast area seems to have been carved out by the hand of nature with consummate design.

A glance at a map will show that this area embraces nearly all of North and South Dakota, the north half of Wyoming and the eastern portion of Montana.

An examination of the topography of this area discloses the cause of many conditions. Starting at Sioux City, Ia., and going northward along the course of the Jim river, which is the lowest part of the basin, we find the elevations above sea levels as follows: Sioux City, 1,097 feet; Huron, S. D., 1,285 feet; Columbia, S. D., 1,315; Jamestown, N. D., 1,406 ft.; and at Devil's Lake, 1,464 feet, showing a gradual ascent northward of a little less than one foot per mile.

Going east from the Jim river, say at Huron, we reach the "divide" between the Missouri and the Mississippi valleys at Lake Benton, Minn., at an elevation of

about 1,900 feet, or 600 feet above the Jim river. Again going westward from Huron we reach the summit of the "coteaus," which is the dividing ridge between the Jim and the Missouri rivers, at about the same elevation as at Lake Benton, Minn., or 600 feet above the Jim at Huron. We then descend to the Missouri river at Pierre, reaching an elevation of 1,440 feet. Crossing the Missouri we reach the top of the bluffs on the west at about 1,700 feet above sea level. The ascent is then gradual till we reach the foot of the Black Hills, say at Rapid City, where we are at an elevation of 3,192 feet, about 150 miles west of Pierre, making an average ascent of about 9 feet to the mile. The general elevation of the Black Hills is about 7,000 feet. Harney's Peak being 8,020 feet. Going westward we find the summit of the ranges of mountains dividing the headwaters of the tributaries of the Missouri and the Platte in Wyoming to be about 10,000 feet. Going northward we find the summit of the mountains in Montana, dividing the headwaters of the Missouri and Columbia rivers, to be about 7,000 feet. Or, in other words, that Montana is 3,000 feet lower than Wyoming. Now, going eastward we find the dividing ridge between the valleys of the Missouri and the Assiniboine to be a little over 2,000 feet.

This gives us the contour of this vast catch basin and shows clearly why the flood waters flow to a common center. Now let us examine briefly the geological structure of this area and see if we can find a receptacle for the storage of phreatic waters.

East of the Missouri river we have first the drift or quaternary ranging from 50 to nearly 100 feet in thickness, with a general average of about 100 feet. First is the soil or black loam ranging from 1 foot to 6 feet in thickness, ordinarily yellow clay comes next, underlying the soil. Yet in many places we find sand immediately under the soil. The yellow clay is ordi-

narily about 25 feet thick. In this yellow clay we frequently find sheets of sand varying in thickness and extent. Nearly all these sand sheets or "sand pockets," as we sometimes call them, are filled with water.

Under the yellow clay and above the blue clay is generally a stratum of water-bearing sand. Here we get what we call our shallow or surface wells. In many of these wells we get quite good water, in some of them the water is not fit to use. As these wells are supplied by water imbibed from the rainfall, many of them fail in extreme dry seasons. Yet some do not. In these wells the water seldom rises above where we find it. We next come to the blue clay; this is about 65 feet thick. Under this we ordinarily find a stratum of sand varying in thickness from a few inches to 30 or 40 feet. In this sand we expect to find an abundance of pure and good water that comes rushing up, sometime flowing out at the top of the well. As the elevation increases and as we approach the hills or coteaus on either side of the Jim, the water does not come so near the surface. But the water always rises and is abundant. Chemical analysis has failed to find a trace of animal or vegetable impurity in this water. In some instances there seems to be mineral deposits in the vicinity of the well which renders the water unfit for use. But in most cases the water is pure and wholesome.

These wells do not fail in our driest times. This fact has led some to believe that these wells were at least partly supplied by a leakage upward from the artesian waters beneath, and there is some evidence to justify this belief. The principal supply is evidently the imbibition of the rainfall on the highlands of the State, which finds its way down into the sandy stratum that underlies the blue clay, and is thus stored in this vast receptacle ready for man's use.

We now come to the shale of the cretaceous formation. This blankets this entire catch basin, and from its impervious nature holds the waters down that are in it and beneath it. I will not stop to designate between Pierre, Benton and Niobrara shale, but call it all shale. As we pass down through the shale we soon begin to find sandy streaks; these increase in number and thickness until we find what is known as the Dakota sandstone, which is the base of the cretaceous formation. In

the southern part of the State we find the Dakota sandstone at about 500 feet; in the central part of the State at about 900 feet; in the northern part of the State at about 1,000 feet; at Jamestown, North Dakota, at about 1,500 feet; at Deloraine, Manitoba, just across the boundary, they are down 1,800 feet, and have not found it yet. On the east side of North and South Dakota it abuts against the Minnesota granite. At the Black Hills, and all around the mountain rim, it crops out.

This Dakota sandstone is the receptacle and source of our artesian waters. It varies in thickness from a few feet to nearly 200 feet. The line of demarkation between the shale and sand-rock is not sharply drawn, the upper part being nearly all shale and the lower portion being nearly all sandstone. We must consider the aggregate thickness of the various sandstone strata to understand its storage capacity. The broken condition of western South Dakota and all of Wyoming and Montana drained by the Missouri river affords abundant opportunity for the imbibition of the storm waters.

According to the weather bureau, the average annual rainfall of South Dakota, taking the entire State, is about twenty inches. It ranges from about fifteen inches in the driest to about twenty-six inches in the wettest portions. Wyoming and Montana are about fifteen inches; North Dakota about eighteen inches. In the broken and rugged part of this vast catch basin a large portion of this rainfall (and this includes snow) finds its way down through the broken rocks and sandy streaks and is silently stored away in the sandstone for man's use. Just how much of this water is thus impounded we cannot at present tell, and conjectures are idle. We do know this, that the capacity of this vast storage basin is beyond computation. We do know that it is full to bursting, notwithstanding there are vast leakages on the southern border. We do know that its upturned mountain rim, with its shale-blanketed surface, affords the means of both hydraulic and hydrostatic pressure, as is evidenced every time a hole is made to give it vent.

There seems to be an arm or tongue of the quartzite reaching out westward from Sioux Falls by Mitchell toward Chamberlain. South of this line the pressure is about fifty pounds to the square inch;

north of this line the pressure ranges from 100 to 185 pounds to the square inch, according to location and other conditions.

The flow of the wells vary largely, from a few hundred gallons to nearly or quite 4,000 gallons per minute, according to the location of the well, its size, the thickness of the sand-rock, its character, whether fine or coarse, and many other conditions I cannot discuss in this paper. It may be that this basin will soon be emptied, but it seems to me that as long as the rains

and snows continue to fall, and the mountains continue to lift their majestic heads high above us, the danger is remote.

With a sheet of water under us thirty or forty feet thick, with a head reaching back hundreds of miles and thousands of feet above us, and being constantly increased by a fresh supply, it seems to me there is no cause for alarm. The resistance of the sand-rock holds this water back, so that we cannot draw this water off rapidly if we would.

ONE REASON WHY FARMING DOES NOT PAY.

BY W. C. FITZSIMMONS.

THE following facts and figures show the stupendous folly of raising wheat for export at recent low prices: For the first eleven months of 1894 there were exported from the United States 65,465,292 bushels of wheat and 14,762,232 barrels of wheat flour. Reducing the flour to its equivalent in wheat at the rate of $4\frac{1}{2}$ bushels to the barrel, the entire export was equivalent to 131,895,336 bushels of wheat. The average price of wheat at points of export was 59 cents per bushel, making a total value of \$77,818,248 for the eleven months ending with November of that year.

It should be remembered that the above sum was not what the farmers received for that amount of wheat exported. Not by a long way. The wheat buyers, the transportation companies, the elevator companies, the warehouse companies and other handlers as well as the men who produced the wheat are all paid out of the amount received. The 59 cents, therefore, represented what the farmers received plus all the charges attaching to the grain from the time it left the farmers' hands until it was put aboard ship in New York or San Francisco.

It is not recorded that the transportation companies or other agencies having to do with this wheat after it left the farm lost anything by the transaction, but how was it with the farmer?

We shall say nothing about the cost of land and improvements; nothing at all about the labor and expense of plowing, sowing, reaping, threshing and hauling to market. To be sure they are generally regarded as the main costs involved in the production of wheat; but our purpose is to show here an enormous item of loss to

farmers which is seldom, if ever, taken into account.

To reduce a large amount of "ciphering" to a few figures it is this: At the prices of 5 cents a pound for potash, 6 cents a pound for phosphoric acid and 15 cents a pound for nitrogen, every bushel of wheat produced cost the farmer who produced it $23\frac{1}{2}$ cents for these ingredients alone. To be sure he may not have paid out that much hard cash for these substances with which to fertilize his crop; but that amount of such ingredients was withdrawn from the soil, which is practically the same thing. No man who raises wheat can possibly escape these inexorable facts of chemistry. This being a fact then the amount of wheat sent across the sea during the first eleven months of the year 1894 carried away from our soil potash, phosphoric acid and nitrogen to the value of \$30,995,400, and for the first eleven months of 1893 the amount was \$40,219,964.

The farm value of the entire wheat crop of 1893 was given in round numbers by the Department of Agriculture at \$213,000,000, and that of 1894 at \$225,000,000. From this it appears that during the first eleven months of 1893 the value of the potash, nitrogen and phosphoric acid exported was equal to 19 per cent of the value of the entire wheat crop harvested that year. In 1894, owing to a greater aggregate farm value for the crop and smaller exports, this percentage was reduced to 14. But in spite of these facts, which can tell but one story of inevitable disaster if persisted in, the farmers increase their acreage in wheat from year to year while the price goes lower and lower.

THE ART OF IRRIGATION.

CHAPTER XV. THE IRRIGATION OF HILLSIDES. WINTER IRRIGATION.

BY T. S. VAN DYKE.

THE modes of applying water so far given cover all ways that are generally justifiable in field, garden or orchard. Special cases on small scales will often justify the expense and trouble of sub-irrigation and sprinkling. But one should be cautious about deciding even this point. There are lawns by the score in Southern California that are flooded, yet look just as fine and soft as those that are sprinkled and do not take one-fourth of the water or one-tenth of the trouble. It is all in the laying out. The same with flowers of all kinds. Whatever you can do by sprinkling you can do more easily with little furrows or basins around them provided you do it right and give plenty of water when you give it at all. The idea that the absorption of water by the leaves makes them look brighter is old granny nonsense. So while such things as strawberries could be kept clean by sub-irrigation they can be kept just as clean by setting them on high broad ridges between deep furrows and filling the furrows with straw or some good mulch. If the ground is carefully laid out to even grade and the furrows well made, the water, if fed evenly to the furrows, will never rise above the mulch.

When you once admit that looks are of no consequence, the problem of irrigating hillsides is half solved. Yet it is marvelous how general is the idea that hills cannot be irrigated and how stubbornly the idea clings to the average skull. What is today the most valuable, elegant and profitable part of Redlands, California, is slope that in 1887 was considered too great for the use of water. And some of the very best is land that three years later when the orchards were fast scaling the heights was still thought too rolling to be of use. The Indian and the Mexican had for a hundred years grown rows of trees along ditches running along steep hillsides and in this way raised some of the finest fruit. And still the white man did not see that the principle could be extend-

ed to several furrows instead of one and to a whole orchard instead of a single row of trees. And outside of California you will be called crazy today for intimating that slopes of even one to one can be irrigated. Yet fine orchards stand on slopes almost as bad as that today and they are not terraced either.

All you have to do is to abandon all ideas of quincunx or any other symmetrical form and plant the trees around the hill on those lines on which the water will run best. First the whole should be graded to a face or faces of uniform slope as in any other land. Then the lines running lengthwise of the hill on which the water will run may be determined, by trial, by simply letting the water follow the hoe as the Indian builds his ditch. Having found the slope on which it will run without cutting or becoming muddy you can continue in this way if you use care enough or can go faster with a board and a carpenter's level. Suppose you find fifty-five feet to the mile about right. This is about two inches in sixteen feet. A sixteen-foot board beveled on one edge until it is two inches wider at one end than at the other, when set with one edge horizontal will represent the slope with the other edge. So if you keep the upper edge level with a common carpenter's level the lower edge will be the grade of the furrow desired. Small mistakes will not matter. Three strips of scantling nailed into a triangle with a nail for a plumbbob hanging from the apex are also very good. Level the base of the triangle and then find how much raising of one end makes the plumbbob swing off, say an inch from a mark made where the string hangs when the base is level. You can easily give any grade you want in this way. You can also do the same by nailing blocks on the end of the plank instead of beveling but it will be harder to follow than the others, which give the exact line of the bottom of the furrow.

When a row of trees is set on one of these lines it makes a good guide for the plow in the future, and as it is about as easy to make curved furrows as straight ones when you have a guide, there is no trouble about having the intermediate ones nearly parallel to those next the trees.

Sometimes these furrows are fed from a row of hydrants at one end and if the hill is very steep they are better than a flume down which the water may rush too fast. But you can use a flume with very little loss of water from flying over, by making it a little deeper than is needed and laying it in steps with a slight covering at the points where the water is likely to spill. But many flumes are laid straight down the hill and made extra deep with little cleats at the holes to throw out enough water. If made deep enough there is little loss from spilling. In other respects this is just like the small furrow method on common ground, and you will soon forget all about the difference in looks.

Where basins are used they are made very long and narrow so as to avoid having the water too deep on the lower side. And on this ground it is still more important to feed the basins from furrows for you will find any other method troublesome, where the slope is great. You must in all cases use more care to keep the water from escaping and cutting.

An orchard laid out in this way and well cultivated is liable to cut under heavy rains. To prevent this, run all plow and cultivator lines lengthwise of the hill and none up or down or quartering. The water from the rain will then get no such start as it otherwise would.

In California the weeds and grass are allowed to start with the first rains and grow until spring. A very slight growth is enough to bind the soil so that it will not cut under a heavy run of water unless too long continued. As the rains come here in winter, when cultivation is of little importance, no harm is done and the weeds and grass are easily cleaned out in the spring.

Where a hillside is very steep terracing often becomes the best mode of preparing it for irrigation. The water is then run along the terraces in small streams or into checks or basins as desired. Some very fine orchards and vineyards are now

seen on hundreds of hills where but a few years ago it looked as if a goat would need several good props on the lower side to enable him to feed. The terraces are made broad or narrow according to the depth of the soil, the character of the crop and the way the water is to be applied, as well as the purse of the owner.

Hillsides generally hold moisture well on the northern slopes and dry out rapidly on the southern. This must be remembered in deciding what to plant on hillsides, as well as the difference in the time of maturing the crop. Many things like grapes and olives seem to do as well on the steepest hills as elsewhere, the only difference being in the ease of handling water. Where you are using basins see that the most water goes on the upper side of everything. Otherwise there is little difference between the steepest hill and the flattest ground.

NOT CONFINED TO ORCHARDS.

Hillside irrigation is by no means confined to trees. The same principle of planting on the lines on which water will run the best without cutting, apply as well to most all vegetables and garden stuff as well as flowers. Nor is there any trouble in growing alfalfa on considerable of a slope if you once get it well started without cutting. When well up the roots will hold the soil against quite a run of water. I know no place where large fields are raised in this way because bottom land is so much cheaper. But there are hundreds of small patches that show plainly that it can be easily raised on any slope on which you can run a mower. And it takes less water than flooding generally requires. There is no reason why the same could not be done with grain, provided the ground were so wet at planting that no more water was needed until the grain was quite high, when the stalks and the grass that would be among it would prevent any cutting. The furrows must of course be made before planting and then not disturbed. If the water wanders out of them in course of time it will make little difference.

WINTER IRRIGATION.

Little attention is yet paid to winter irrigation, because its necessity has not been thoroughly felt. But time will see the field of irrigation much extended by

the use of water at a time when it is now almost everywhere allowed to run to the sea.

Where a country is underlaid by sheet rock very near the surface, through which the water can travel only in fissures, moisture cannot be retained very long by any means. But where the subsoil is porous and retentive of moisture, or where the top soil is very deep and of about the right mixture of clay, sand and gravel, the length of time it will hold moisture enough for many crops is very great.

Southern California ships annually about fifteen hundred carloads of beans that are raised without irrigation and generally without rain, and always without rain that amounts to anything. The grower aims to keep the seed out of the ground until the last rain of the season is over, so that he can start out with the ground so cultivated that the winter weeds and grass are killed. The beans will then get ahead of the summer weeds and grass, which are much later. Consequently the entire crop is raised on the moisture stored in the ground from the winter rains and retained by good plowing and pulverization of the top soil into a mulch. Corn and many vegetables are raised in the same way, while over one-half the entire fruit crop of the State and probably four-fifths of the deciduous fruit trees never get a particle of water or rain after the setting of the fruit. It is difficult to see why this cannot be done anywhere else where the depth of soil or porous subsoil is great enough, as it is on the greater part of what is called desert. If the winter rainfall of twenty inches, of which one-third runs off and is lost in direct surface evaporation, will do it, it is certain that a foot or fourteen inches in depth from a ditch will do the same thing where the summer is not too hot and dry. And where it is so hot and dry as to need more water, it will not need what it would had the ground not been wet in winter. And on the greater part of it the raising of a fair crop of grain on ground thus thoroughly wet should be an easy matter without farther wetting, and enough for a profitable crop of hay a certainty.

The difference in California between the amount of water needed in the summer following a very wet winter and a very dry one is enormous. And still more surprising is the way the water in the ground

from an extremely wet one is carried ahead to the second year. After the very wet winter of 1883-4 when, on the greater part of the lowlands, forty inches of rain fell in four months, hardly anything needed water until very late in the fall, and then it was needed mainly by oranges and lemons in full bearing. Almost everything that matured its fruit by September was fine without any irrigation. Crops of corn equal to the best ever seen in the prairie states were common all over the uplands a hundred feet from any subterranean water and leagues beyond the influence of any coast fogs or moisture.

The next winter was a very short rainfall with very bad distribution. Yet the effects of the great wetting of the year before were everywhere plain in the summer following this short rainfall. Crops of grain, corn, beans and various other things were raised everywhere on the uplands to an extent that would have been utterly impossible on the amount of rain of that second winter.

Probably two feet of water entered the ground that wet winter. There are few irrigation systems that are worth anything that cannot in addition to the summer supply furnish at some time of the year this quantity of water to consumers. If in a state having a wet winter season like California, the rainy period is generally long enough to put more water than that amount into the ground; if on a desert like the Colorado where the high water comes during the irrigating season the winter is long enough, and there is then water enough in the river to fill the ground quite well. There are exceptions, as on the Rio Grande, where I have seen the winter-flow insufficient to wet much territory. But I have seen times there in the spring when a vast amount of water went to waste that could have been employed somewhere in filling up the subsoil. As a rule there is at some time plenty of water under any system that could be had without extra charge and in addition to the regular water-right, as it costs nothing to carry it in aqueducts already built. But so far as I have seen, the fault lies not with the companies, but with the consumers, who will not use the water but prefer to take their chances on there being plenty in the dry season.

If water cannot be stored above ground the next best place is in the ground, and

there are but two objections that can be made to filling the ground in winter.

The first is that it chills the soil too much. For oranges, lemons and a few other things ripening at this time, care should be taken against applying water too cold. But for grain, deciduous fruits and all crops not planted until warm weather, such as corn and beans, it can do no harm. In California most deciduous fruits are all the better for being held back by cold ground, as is shown by the superior quality of the mountain fruit over that of the lowlands. Some, such as cherries, apples and some varieties of plums and pears, actually demand a soil cold in winter. Probably such is the case in all the lands of sunshine.

The second objection often made is that if the season turns rainy toward the end, you then have the soil too wet. The winter of 1883-4, above referred to, proved that in California there is little in this objection. On all ground well enough drained to be fit for oranges or lemons at all, the quality of the fruit was not in-

jured by the excessive soaking of that winter. On low ground, trees of many kinds were killed, and some of the raisins grown on them were too watery, but there was no trouble with anything on the uplands. While there is in some places a possible danger of having the ground too wet, there is more of having it too dry. And while the quality of fruit may be impaired by over-irrigation, the danger is seldom alarming. Men do suffer from over-work, but there is much more suffering from under-work. It is the same with spoiling flavor with too much water. And if you are working the ground for lucre instead of glory, it may even pay to sacrifice flavor to size. For, deplore it as we may, man is still the master fool of the universe, and first, last and all the time he grabs for the largest fruit, whether fresh, canned or dried, and gladly pays for looks what he will not pay for merit.

NOTE.—Owing to the fact that our offer to allow editors to use T. S. Van Dyke's articles, provided due credit was given *THE IRRIGATION AGE*, and also provided the articles were not used consecutively, has been grossly abused in many cases, the offer is now withdrawn, and the copyright will be fully protected.

WATER SUPPLIES FOR IRRIGATION. STORAGE RESERVOIR SITES AND CANALS.

BY F. C. FINKLE, C. E.

VERY frequently good reservoir sites are found without any adequate watershed which is directly tributary to them and from which they can be filled. In such cases, of course, the reservoir sites are valueless as such, unless water from some adjoining watershed can be conducted into them. Before a reservoir site is condemned and rejected on account of not possessing a watershed sufficient to fill it, an examination should be made to determine the practicability of filling it from some other adjacent watershed. Surveys for this purpose should be made of the watershed under contemplation in the same manner as has been recommended in the case of a watershed directly tributary to the reservoir site, with the following additions: A suitable point or points of diversion should be selected at a sufficient elevation above the proposed reservoir site to permit the carrying of the water to be diverted from the point of its diversion into

the reservoir site at a point not lower than the top of the dam.

The survey of a line suitable for a canal or other conduit for carrying the water from the watershed to the reservoir site should be made with sufficient accuracy to give its length, grade, cross-section and other data necessary for estimating its cost. A canal of this kind is called a storage reservoir supply canal, as it is used to perform the function of supplying water to a storage reservoir.

Storage reservoir supply canals partake of the nature of other canals used for carrying water for irrigation purposes, and their construction must be carried out in accordance with the same principles which will be laid down for the construction of irrigation canals in one of the succeeding chapters devoted to that subject. There are a few differences, however, arising from the fact that their use is confined to the rainy and cold season of the year,

when they are sometimes required to carry very large volumes of water in a very short space of time. It therefore follows that they must be of much larger size and capacity than if the carrying of all the water required were evenly distributed over the entire season. To determine what the capacity of such canals should be, it is necessary to know the maximum floods from their watersheds and what portion of the flood-waters is required to fill the reservoir sites they are intended to supply.

Another point requiring special care is the construction of the diversion dams to take the water into such canals. The suddenness with which the floods rise and fall and the large quantities of water the dams are required to handle, make it necessary that they should be made very safe and strong. Should the diverting dam fail, the water needed to fill the reservoir might run to waste before the dam could be repaired, and another opportunity might not occur to obtain sufficient water for filling the reservoir before it would be needed. Hence the importance of perfect designing and construction of head works for such canals. Often the elevation of storage reservoir supply canals is considerably above sea level, so that even in warm climates there may be danger of their filling up with snow and ice at the time when they will be most needed. It is frequently the case in semi-tropical climates that considerable snow falls and cold weather occurs at high elevations just before and during the time of heavy rains. This being the case, canals in such places may be filled with snow and ice when the water comes down which they are intended to carry off. The way to overcome this difficulty is by the construction of snow-sheds to prevent the drifting snow from filling the canal. These matters will be more fully discussed in the chapter on canals, but are referred to in this place for the purpose of showing which are the principal matters to be considered in making estimates of the cost of bringing the water from a watershed not directly tributary to a reservoir site into such reservoir site.

PROXIMITY OF RESERVOIR SITES TO LANDS SUSCEPTIBLE OF IRRIGATION.

In general, the points already discussed cover everything essential to impart value to a storage project. Sometimes, however, reservoir sites are found so distant from lands where the water can be used for

irrigation that the cost of bringing the water to the lands, added to the cost of the reservoir, is greater than the profits to be realized from the enterprise will warrant. This is especially the case where an artificial channel to convey the water for the whole distance has to be provided. It is, therefore, always a part of prudence and good practice on the part of an irrigation engineer to know what will be the expense of conveying the water proposed to be stored by a reservoir to the lands where it is intended for use. For this purpose surveys of one or more practicable routes from the reservoir site to the point of delivery on the land to be served should be made.

These surveys should be made with sufficient precision to furnish the data required for making thoroughly reliable estimates of cost. In cases of reservoirs very distant from lands susceptible of irrigation, it is often possible to convey the water in the natural channels of rivers and streams for the greater part of the way. Thus it is often feasible to make a large saving in the expense of constructing artificial channels by utilizing those which nature has already provided. It does not follow, however, that all which is necessary is to find a natural river or creek channel in which the water will flow down to or near the place required. It often occurs that the loss of water in such conduits is so great as to make their use impossible. This point must therefore be investigated in order to find what will be the percentage of loss. Such examinations can either be made by actual measurements at times when water is flowing in the channels in question, or by comparison of the conditions and nature of the channels with others in which the percentage of loss is already known. It should be remembered, however, that the former method is always the more certain and reliable, and is therefore to be preferred.

A CORRECTION.

There was an error in the formula in the second column on page 19 of the July number being in line 23 of that column from the top in Finkle's article on Water Supplies. The error consists in making the fractional number $\frac{1}{2}$ appear as a factor in the formula instead of as the coefficient of the factor A. The formula will then read as follows, which is the way it was intended: $Q = \frac{1}{2} A$ (pcf).—Ed.

DECISIONS UPON THE SUBJECT OF WATER RIGHTS.

BY CLESSON S. KINNEY, OF THE SALT LAKE CITY BAR.

IT is safe to say that California owes the greater portion of the prominence which that State occupies to-day to the results of irrigation. The localities where irrigation has been practiced the longest and the most extensively have gained the widest reputation outside of the State. Almost every step taken in advance in California's prosperity, since the subsidence of the first great rush for gold, has been anticipated by new and more extensive irrigation developments. It is no exaggeration to say that were it not for irrigation the fame of California would be confined to the mining industry, and she would not have more than one-half of her present population. Without irrigation the major portion of the State, which is to-day thickly populated and in the highest degree productive, would still be in its original barren condition.

The methods of practicing the art of irrigation are many and diverse. We can also say the same of the laws regulating and controlling its practice. Its laws permit the acquisition and retention of water rights by means of all the known systems. One can acquire title to water rights by the means of prior appropriation, whereby he diverts the water from the natural channel and applies it to irrigating the soil or to some other beneficial purpose. The riparian proprietor is protected in his rights in and to the waters of the stream or the lake flowing over or adjoining his land, and greater license is allowed him than was permitted under a strict construction of the common law rules, in his being permitted to divert from the stream a reasonable amount of water for the purpose of irrigation. Rights acquired under the civil Spanish and Mexican laws, before California was transferred to the United States, are protected to the fullest extent. Also, at different times, statutory enactments have been passed by the State Legislature regulating and controlling the uses of water. And last, by the statutory enactments of 1887, and the subsequent amendments, the "District System," familiarly known as the "Wright Law," was created, which is without doubt the most

famous irrigation law in the United States, although it has been held by some courts to be unconstitutional. This view of the law seems to the writer to be the wrong one. But how the Supreme Court of the United States will decide the case which it has before it remains to be seen. But it is unfortunate for the people of California that the case could not have been decided this spring, instead of being kept under advisement over the long summer term. However, it may result in the case being decided right. It is a great subject. There are some of the old principles of law that may have to be modified. But there can be no question but that the law, in a great degree, meets the needs and necessities of the arid West.

RIGHTS OF RIPARIAN PROPRIETORS.

It has always seemed strange to the writer that the legislature and courts of California should try to reconcile and retain principles of law governing waters so adverse to each other. Take, for instance, the laws of appropriation and diversion as against that of riparian rights. In the first, in order to hold the right, the water must be diverted from the natural channel of the stream and actually applied to some beneficial use. In the latter the stream must be permitted to flow, as it was accustomed to flow, without any substantial deterioration in quality or diminution in quantity.

One of the methods of reconciling these adverse propositions is seen in the case of *Wiggins vs. Muscupiabe Land and Water Company*, decided on the 5th of June, 1896, and reported in 45 Pac. Rep., 160, where it was held: That in determining the rights of riparian proprietors to the waters of a stream, for irrigation, it is within the power of a court of equity to apportion the flow by periods of time, rather than by division of the quantity, when such apportionment may be extended to the use of the water for domestic purposes, when necessary.

Mr. Justice Harrison, in rendering the opinion of the court in the above case, said: "The power of a court of equity to

apportion the flow of water in a stream to the respective riparian owners by periods of time, rather than by a diversion of its quantity, so that each may have the full flow of the stream during such designated periods, instead of a portion of the flow during all the time, when the circumstances are such that a division in this manner would better conserve the rights of all the riparian owners, was fully considered and established in *Harris vs. Harrison*, 93 Cal., 676. It was said in that case: 'According to the common law doctrine of riparian ownership, as generally declared in England and in most American states, upon the facts in the case at bar the plaintiffs would be entitled to have the waters of Harrison canyon continue to flow to and upon their land, as they were naturally accustomed to flow, without any substantial deterioration in quality or diminution in quantity, but in some of the western and southwestern states and territories, where the year is divided into one wet and one dry season, and irrigation is necessary to successful cultivation of the soil, the doctrine of riparian ownership has, by judicial decision, been modified, or rather

enlarged, so as to include the reasonable use of natural water for irrigating the riparian land, although such use may appreciably diminish the flow down to the lower riparian proprietor, and this must be taken to be the established rule in California, at least where irrigation is thus necessary.' In an arid country water for irrigation may become a natural want of man, as exigent as when needed for domestic purposes, since without it vegetation would cease, and the sources of life be indirectly destroyed. When, as in the present case, a stream, instead of increasing as it goes toward the sea, constantly diminishes, until it finally disappears, or ceases to have any appreciable volume, it is very evident that its beneficial use can be regulated better by periods of time rather than by a division of its quantity. A perpetual use of the water by all of the proprietors would be impracticable, for the reason that a perpetual use by the upper proprietor would, during a large portion of the year, entirely deprive the lower proprietor of any flow, and a just protection of the rights of both is best effected by a division in periods in time."

A FURROW-MAKER.

BY JOEL SHOMAKER.

A FURROW-MAKER is valuable to all classes of farmers in every section of the country. The irrigated districts require field furrows in order to properly distribute moisture. The prairie farmers need furrows to guide in planting and cultivating. Where land is level, furrows are beneficial in wet seasons for drawing the surplus water from the growing crops. In dry weather the same furrows retain what moisture falls, and distribute it by seepage and percolation to the roots of the crops in plats between the furrows. Furrows facilitate the cultivation and harvesting of crops. As every farmer must have more or less furrowing, the best, easiest and cheapest methods of making are always sought.

An old backwoods Western farmer has discovered what he thinks is a model method for making furrows. All his crops are rolled after planting, and as irrigation is required, he must have distributary furrows. These are made by having a furrow attachment upon the roller. His

roller is made of wood. A big cottonwood log ten feet in length was hewn down to make the roller. Three feet from either end of the log he left the log full size and chopped down, sloping on either side, leaving the extra sap probably three inches wide on the outside. The main body of the roller is probably six inches lower than these rings of timber. In driving over the planted field, the roller levels the land and the rims of timber cut in and make the furrows.

To prevent the pieces of wood from breaking off, the entire rim was covered with an old wagon tire and spiked with twenty-penny wire nails. Straight furrows can be made as easily with the roller as with any other two-horse implement. The driver sits in the center in a spring seat and has nothing to watch but the course of the roller. This method could be used on rollers not made of logs just as well. Iron bands would answer the purpose if they were large enough and properly put upon the roller.

ONE YEAR OLD APPLE ORCHARD, K. S. D. RANCH, NEAR ONTARIO, ORE.

FOUR YEAR OLD ORCHARD.

WELL DRILLING MACHINERY.

WITHIN the past two years thousands of wells have been sunk on the western plains, in what is distinctively known as the sub-humid regions, for purposes of irrigation. The universal success of such wells will insure the rapid adoption of this method of reclaiming arid or semi-arid lands. In many places it is the only resource; in many others, where water supply is accessible from canal systems, it is found to be much less costly in the long run, and much more satisfactory, because of the independent control it affords. There are few localities where water is not found coursing in underground channels, close enough to the surface and in sufficient quantities to provide for the necessities of a few acres of land, and even though not more than five or ten acres on a quarter section can be irrigated, that is quite enough to insure the farmer a good living, and if well handled, a considerable surplus every year, regardless of the natural rainfall. Indeed, a single acre of garden has served this purpose in many instances. The balance of the farm will always yield something, if it is only in pasturage, and the wells will incidentally provide ample stock water. When the seasons are favorable the products of the remaining acres will be a clear profit.

Nor are such wells only practicable in the localities named. The time is not far distant when irrigation will be adopted in every part of the country where intensive farming is practiced, even though it be only as a "tide over" for dry periods. Vegetable and fruit growers are learning that the cost of installation and of maintenance of a pumping plant that will insure them full crops every year is one of the best investments that can be made in

connection with their business. The hay crop, which is the chief money crop in many sections, is so greatly increased and improved by a bountiful supply of water at all periods of its growth as needed, that it will justify far more than the average expenditure needed to provide for irrigating water. There are few localities where such an increase in crops as is assured will not justify an annual expenditure, including the interest on investment, of five or six dollars an acre, and under ordinarily favorable conditions it will not cost half that.

Motive power utilizing wind, gasoline, oil, coal or wood for fuel is being so cheapened and perfected that either of them are found to be practicable, each having special advantage in some localities. Pumps with large capacity and specially adapted to the wants of the irrigator are now on the market, and the competition has cheapened them until they are within the reach of all. Well drilling machinery has been improved, and at the same time its price has been so reduced as to make that part of the problem an easy one. In fact, all the elements are now in combination to promote the rapid extension of the individual irrigation system.

Unfortunately there are not many manufacturers of this line of machinery, as it is one requiring many years of experience to produce machines which do not prove more or less troublesome and expensive. Among the most reliable are the F. C. Austin Manufacturing Company and the Chicago Tubular Well Works, both of Chicago. The tremendous strain to which well-drilling machinery is subjected should cause the purchaser to be very careful when buying, so that he may get machinery that has been fully tested and approved.

THE DIVERSIFIED FARM

In diversified farming by irrigation lies the salvation of agriculture

The Age wants to brighten the pages of its Diversified Farm department and with this purpose in view it requests its readers everywhere to send in photographs and pictures of fields, orchards and farm homes; prize-taking horses, cattle, sheep or hogs. Also sketches or plans for convenient and commodious barns, hen houses, corner ribs, etc. Sketches of labor-saving devices, such as ditch cleaners and watering troughs. A good illustration of a windmill irrigation plant is always interesting. Will you help us improve the appearance of The Age?

HOW CULTIVATION PRESERVES THE MOISTURE.

BY F. C. BARKER, OF NEW MEXICO.

THAT cultivation of the upper crust of the soil tends to prevent evaporation of the moisture below, is a fact that every practical farmer is well aware of. It is daily being proved in actual practice, but the scientific theory upon which this phenomenon is based is little understood. Men will tell you it is so, but why, they do not understand.

Now, it is well known that the soil is composed of innumerable and infinitely small particles. When the soil is dry each little particle is surrounded by a vacuum or air space. Whenever the particles come in contact with moisture, they have the power of attracting that moisture and of surrounding themselves with a thin film of water. The particles next to the water first draw the water around themselves, then the dry particles next to them in turn attract it, and so a continuous stream is set up, much in the same way that a wick of a lamp draws up the oil. This goes on until the whole body of soil is saturated, but as soon as the water reaches the particles on the surface of the soil, this water is evaporated, and the supply below is again drawn upon, until the water stored below is so exhausted, or left at such a depth, that the distance overcomes the power of attraction and the soil becomes completely dry. This is the process which goes on in uncultivated soil.

The object of cultivation is to break up this attraction, usually called capillary attraction, in the upper crust and so prevent the moisture from being brought to the surface and evaporated. To understand how this is done, one must take into account another scientific fact, and that is,

that if these little particles in the soil be widely separated from each other they lose their power of attraction. Now, when the top crust of the soil is loosened and reduced to a fine tilth, these particles lie less closely together and do not attract moisture from below. The moisture now rises as high as the upper tilth, and there remains to a much longer extent than in the case of untilled soil, for owing to the blanket or mulch of loose soil on the top, the soil below the surface is much less exposed to the action of evaporation.

Some of our farmers here are unwilling to accept the above theory, alleging that adobe or clay soil, that has never been cultivated for years, will have more moisture below than cultivated soil. If this be so, the fact does not clash with the theory of particle attraction. On such soil the top surface has been packed down so closely that the surface is practically puddled, in which case the attractive power of the particles is destroyed. It is the same as though the surface were covered with a large rock or a board, whereby the evaporation were suspended. Every one knows that moisture may almost always be found under a large rock. The idea is to cover the soil with something that will suspend the attractive power of the soil-particles and retard evaporation.

Herein lies the whole secret of why land should be cultivated after each irrigation or heavy rainfall, if the farmer wishes to conserve the moisture in the soil. There is also another and very important reason why crops should be cultivated after each irrigation. The roots of plants require air quite as much as they do water, and when the soil becomes packed or plastered down by irrigation the roots do not get a full supply of air, unless this surface crust is broken up.

MISCEGENATION OF GRAPES AND APPLES.

LA NATURE, a French periodical, mentions a remarkable case of cross-fertilization. Whether it is true or not, we cannot say, but this is the yarn: A grapevine stood near a large russet apple tree, and a bunch of twenty-nine apples formed on the grapevine and grew to considerable size, even if they did not mature, which latter fact is not stated. The "grape-apples" were wedged so closely together that they were "sharpened to a point," somewhat like grains of corn on a cob. The blossom end of each fruit, however, was found to be as perfect as in any other apple. The matter has been taken up by the Imperial Pomological Society, and it is to be hoped that valuable facts may be established from the discussions incident thereto.

ZINC TREE LABELS.

J. D. EASTER writes to the Redlands J. Citigraph: "Your issue of the 20th contains a paragraph concerning 'An Indestructible Tree Label' which I can commend as trustworthy, from many years' experience. I was taught this by a nurseryman thirty years ago, and have practiced it ever since, with satisfactory results. For ordinary use it is not necessary to write on the zinc with chloride of platinum, or any other costly fluid. Clean the slip of zinc thoroughly and write on it with a steel pen dipped in ordinary black ink. The ink will soon corrode the zinc so that the writing will be perfectly legible, no matter how much it may be exposed to the weather. I have labels on fruit trees in my yard which were made two years ago. The ink has disappeared long ago, but the names are there to stay. How they would resist being buried, I do not know, but labels are not usually intended for this purpose."

State Flowers.—While many States have struggled, more or less unsuccessfully, with the momentous question of selecting a "State flower," and have put in nomination all sorts of ugly weeds with horrible names, it is a pleasing piece of news that the school children of Delaware, by an overwhelming majority, selected the peach blossom as a State flower. That shows a degree of horse sense for which

every Delawarean kid should have an extra hunk of gingerbread and a slice of watermelon, besides the usual allowance of peaches and cream. The following is the list of State flowers already adopted by the votes of the public school scholars of the respective States: Alabama, Nebraska and Oregon, the golden rod; Colorado, the columbine; Delaware, the peach blossom; Idaho, the syringa; Iowa and New York, the rose; Maine, the pink cone and tassel; Minnesota, the cypripodium or moccasin flower; Montana, the bitter root; North Dakota, the wild rose; Oklahoma territory, the mistletoe; Utah, the lego lily and Vermont, the red clover. In addition, Rhode Island and Wisconsin have adopted a State tree, the maple being selected by both.

Feeds Eggs to the Calves.—**J. W. Rutherford**, of Sumner county, is very enthusiastic on the subject of alfalfa, cows and creamery. It is not all theory, either. He has had three years' experience with alfalfa and has been one of the largest patrons of the creamery since last fall. He has sold horses and wheat machinery and invested the proceeds in cows. A great many farmers say there is more profit in feeding the milk to calves than in selling it to the creamery, but Mr. Rutherford says he has had fine success with feeding skimmed milk from the creamery to his calves. He thinks he can raise just as good calves on the skimmed milk, and has about \$5 for each cow per month for the cream. He also says he stirs an egg into each feed of skimmed milk, and his calves are sleek and fat. He has made a close study of dairy papers and has got all the information he could from friends in the dairy business in Pennsylvania.—*Exchange.*

Cultivate Rather than Irrigate.—It is easier to turn on water to wet the hard, baked soil than it is to cultivate, but the man who does it will never be apt to reap a heavy reward for his labor. Every such wetting is a positive and permanent injury to the land, putting it into a mechanical condition that makes it difficult to cultivate satisfactorily ever after. Give the soil deep saturation when you do irrigate, and cultivate it as quickly as the teams can be got on, and while it works without

clodding. Keep the surface soil fine and mellow and the evaporation will be hindered while the capillary action will be promoted below.

The Cheapest and Best Fertilizer.—A German authority finds the weight of the stubble and roots of a heavy crop of red clover to weigh about three tons and to contain 180 pounds of nitrogen, 7 pounds of phosphoric acid and 77 pounds of potash. The first was gathered from the air and the other two brought up from the subsoil. These were worth at the market price of these fertilizers about \$30. The stubble and roots of an alfalfa field are much heavier and proportionately more valuable. A good crop of alfalfa turned under when in its best condition and making most rapid growth, or just completing it, is the cheapest method of adding these fertilizers to the soil, and at the same time puts the soil in the best mechanical condition.

A New Fruit Pest.—The sanitary inspector of British Columbia has seized a quantity of Tasmanian apples, arriving by an Australian liner. They were infected by an insect about the size of a flea, which burrows into the apple and deposits its larvæ. It threatens to be a more offensive and worse pest than the San Jose scale, and a united effort will be made by the authorities at all importing points to prevent its introduction into the Pacific coast states and British Columbia.

Milk Tests.—The introduction of reliable milk tests by which it is made practicable to buy milk according to the butter fat it contains will eventually lead to the more just and sensible practice of purchasing it with reference to quality rather than quantity. Recent experiments have shown a range of between three and five per cent. of fat. In one case three hundred pounds of the best would bring as much as five hundred pounds of the lean milk.

Fertilizer in the Water.—The muddy water of the early spring in nearly all the irrigated countries carries more or less fertilizing substance which has been dissolved from the soil, or is gathered by the rush of waters, and it is a wise farmer who schemes to save as much of such value as

is practicable. If the watershed is forest-covered it is all the more important to save the vegetable mold which is so readily carried in the quick-moving current.

Topping and Stripping Corn.—Tests at the Mississippi experimental station during three seasons have uniformly shown a marked decrease in the yield of corn and deterioration in quality which is not compensated by the feeding value of the crops. The records of seven other stations where similar tests have been made show a loss of sixteen per cent. upon topping. Stripping causes even greater loss.

Road Making.—Use fresh soil for the repair of roads. That which has been ground into an impalpable powder and washes into the ditch is not fit to put back again; it is worn out. Remember this in repairing chock holes. The pulverized stuff, mixed as it is with animal droppings, may be an excellent dressing for the gardens, or a good absorbent for the cattle-yards, but it is not good road-making material.

Cool the Fruit.—If fruit is taken from the trees when warmed by the sunshine, it is in an undesirable condition for packing. If practicable to spread it under a shed on straw or leaves to lie over night, it will be thoroughly cooled and in much better condition for shipping. This is particularly the case as to pears, quinces or apples.

Danger from Spraying.—From several localities come reports of injury and death to bees resulting from the feeding on the poisoned blossoms of vines and trees that had been sprayed. Mr. Stroud, of McCook, Neb., found so many dead bees in his hives that he thought it necessary to destroy honey, bees and hives. They had been poisoned by Paris green and London purple mixture.

Don't Waste Manure.—No matter how good your soil may be, never permit the waste of any manure or fertilizing material that may be made or found on the farm. The best of soil may be made more productive; in fact, the best of soils will generally pay best for the fertilizers used on them, if care be taken in providing the particular elements that the soil may be deficient in.

Mixed Grain.—The Ontario experiment station, as the result of two years' tests, finds that a combination of barley, wheat, oats and peas, all sown together, produces 244.05 pounds of grain to an acre in excess of the average yield obtained by planting the same grains separately. The yield of straw is also larger.

Restoring Fertilizer.—Every crop taken from the land removes a certain number of pounds of the three essentials—nitrogen, phosphoric acid and potash. If it is not replaced the land suffers to the extent of that draft upon it. The intelligent farmer will seek the most effective way to restore that loss.

Nut-Bearing Trees are beginning to attract a larger share of attention. They become profitable as producers after seven or eight years and are all the time growing into value as timber, so that in twenty-five or thirty years they will prove themselves among the most profitable of farm products, if cultivated as such.

Low Priced Nursery Stock may not be cheap stock in any sense. Give first attention to quality; find the best, then buy it as cheaply as you can. Don't buy it at all if it is not good. There is hardly any worse investment to be conceived of than to put money in poor trees and in the cultivation of them for a term of years.

Spraying Potatoes.—By the use of Bordeaux mixture, at the Vermont experiment station, the total product of potatoes in 1892 was increased from the rate of 169 bushels per acre from an unsprayed plot to 400 from a sprayed plot. Other stations report similar favorable results.

The Experiment Stations are performing a large amount of careful conscientious work for the benefit of the farmers generally. The latter should not only appreciate it, but good judgment dictates that they should take every possible advantage of it.

A Hint to Potato Growers.—A Connecticut man made a simple and effective spraying machine by mounting a ten-gal-

lon keg on a wheelbarrow and inserting a wooden faucet at each end. He sprays two rows at a time as fast as he can walk, making it an inexpensive operation.

Exchange.—It may be better to exchange good sires, either of cattle or hogs, after they have proven their quality, than to kill them, if it be necessary to introduce new blood into the individual herds or in localities where they have done general service.

Keeping Potatoes.—In a suitably constructed building potatoes may be kept an entire year, or longer, without deterioration, under cold storage. There is no necessity for potatoes to become shriveled or sprouted if kept dry and cold from the start.

Good Cows command the best prices of any animals raised on the farm, and the demand for them is steadily growing. It follows that it is in this direction in which the enterprising farmer ought to turn. The more emphasis there is put upon "good" the better.

A Canadian Fruit Grower experimented with two of his cherry trees by spraying one of them. From the sprayed tree he gathered 130 pounds, which he marketed for \$9.25, and from the other he got but eighteen pounds, which brought him \$1.20.

Sub-Irrigation a Failure.—After five years' trial on the experiment station farm at Logan, the practice of sub-irrigation, in every way that it has been tried, has proven a failure, and about the same results have been obtained at stations in other states.

When to Cut Grain.—Experiments show that grain harvested in the milk or dough makes better yield and better quality than when allowed to ripen on the stalk. It will also gain weight from the straw while standing in the stack.

Escaping Frost.—Prof. Kedzie, of the Michigan Agricultural College, says that tender plants and fruits of all kinds, if thoroughly watered late in the evening when frost is expected, will escape unharmed.

When You Sell Hay off the farm you are selling its crop constituents; when you feed it and make good use of the manure resulting, you may sell the animal product and yet add to the fertility of the land.

A Big Crop of Weeds, if properly utilized, may not be a misfortune. Plow them under when they are making vigorous growth and before any of them have gone to seed, and they will prove a valuable fertilizer.

The Value of the Farm is enhanced by keeping the roadside clear of brush and weeds and trash, not only by tidiness in appearance but by the destruction of weed pests.

Canning Establishments.—The Western canning establishments are driving the French peas out of the American market. By more skillful packing the quality of the home product has been materially improved.

Tree Cultivation.—Trees do not differ in any fundamental method of living from vines and crops that are always cultivated. Cultivation is as necessary to the one as the other.

The Pruning of an Orchard should be practically done before the trees are five years old from planting, and with proper care and attention it may all be done with the thumb.

The Waste of Wood Ashes is almost criminal, as there is hardly anything in the way of a fertilizer which returns so much of value to the soil according to the weight.

Printer's Ink is better than tar to protect seed corn from the birds. Stir a little ink with the corn and then dry by rolling the corn in fine dry sand.

Trees and Plants need food and water, and they should be as regularly and intelligently supplied as the animals on the farm. It is only a difference in kind.

Tree Planting.—Plant the different kinds of trees with a view to separate irrigation. Some kinds need much more water than others, and they need it at different seasons.

Warm Stables.—Building paper, forest leaves or sawdust between the boards to keep the stables warm are much cheaper than grain and hay to keep the animals warm.

Stock that has paid during this long and severe depression will be the most profitable when the good times come again. This is worth remembering and thinking about.

The Costs of Transportation and sale are as large for a poor as for the best article. All the advantage in the way of profit lies with the best product.

Horses are so cheap now and there is getting to be so little for them to do that the farmer can with good grace use riding machinery wherever practicable.

Present indications are that the horse industry will be first to recover from the depression which has characterized the live stock markets.

Good sanitary conditions are the best preventive of cholera or other diseases, and this applies as to men, animals or poultry.

The essentials for summer cultivation are to kill the small weeds and keep the surface loose. Cultivate shallow and often.

A horse's collar in harness should be as carefully fitted as we fit the shoes upon our feet, or the coat upon our back.

You must cultivate your small fruits and trees the same as any other farm crop from which you expect to realize profit.

The commercial demand for horses is growing, and it is getting to be a question how it can be supplied.

A Massachusetts fruit grower estimates the cost of spraying his orchard at ten cents per tree for the season.

Save the best for seed—this applies to colts, calves, lambs, pigs, pullets, grains, fruits and vegetables.

A good rooster is better the second year than the first. Don't make a mistake in killing or selling it.

A cow cannot give full returns in milk unless she receives full feed every month in the year.

MAXIMS FOR THE IRRIGATED FARM

Cultivate as well as irrigate.

Irrigation is the best crop insurance.

Never attempt to do more than can be done well.

The best savings bank for a farmer is his manure pile.

The strongest man is the man who stands for an idea.

The surest way to success is to do well whatever you attempt.

The man who enjoys his work as he does his bicycle succeeds at it.

There are more book farmers and less blockheads than formerly.

New conditions demand new methods in farming as in other business.

Workers make better progress than kickers, whether horses or men.

It is the man who masters the conditions which confront him who succeeds.

It is better to fill your own place in the world well than to covet another man's.

Great crops may make large business, but low prices afford only small profits.

Marketing the crop successfully is of quite as much importance as growing it.

The man who works so hard he cannot think may with reason be classed as a fool.

Intelligence is the tool which makes an opportunity where none else will appear.

Success depends more on the use of the ability one has than on the abundance of it.

Study the application of water in irrigating for its permanent as well as present results.

The man who is better fitted for feeding hogs than for growing fine fruit ought to feed hogs.

The farmer who works most by rule will have the better results to show at the end of the year.

There is no place where careful attention pays better proportionately than in the poultry yard.

The farmer's welfare is the nation's welfare; the last cannot exist in this country without the first.

Drainage is the first necessity in road making. Without it the best work will fail to accomplish its purpose.

It is a careless man who keeps no record of his business, and this applies to farmers as well as to other people.

Don't sell all of the best and perfect fruit; give the family a share. Few children enjoy eating the culls all the time.

A man who is too busy to read the papers is too busy for his own good. It is necessary to keep in touch with these rapid moving times.

When you see a man who has no garden, orchard or fruit patch you may be pretty certain he does not read. He scorns the idea of being a "book farmer."

The farmer who breeds mongrel cattle, hogs or fowls will in time exhaust a big bank account, if he has one, or will become poverty stricken if he has not.

But comparatively little of a man's education has come from books. Experience is the best teacher and its lessons are never ended so long as intelligence lasts.

A man in this age who waits for something to turn up is more than likely to die before the turn comes. The one who turns up something is the more useful man.

The lucky farmer is universally the one who gives the most careful, painstaking attention to the details of his business, whatever branch of the industry he may be engaged in.

The American people do not like to be humbugged in the fruits they buy, and the grower who recognizes that fact when packing for the market will act wisely for his own interest.

It is often better policy for the farmer to sell some of the land he has than to buy more. More land than is properly and profitably cultivated is a burden rather than a benefit.

PULSE OF THE IRRIGATION INDUSTRY

A GOLD EXHIBITION.

A RECENT issue of the Chicago Record contained the following item which explains itself:

A meeting was held yesterday at the Wellington hotel to make arrangements for an exhibition of gold industries in Chicago some time in the fall. The Chicago Western society has the matter in charge, and the intention is to have exhibits from all gold-producing countries, together with an exhibition of the systems of mining, crushing and assaying ores.

The gold regions of Colorado, California, Washington, British Columbia, Oregon and the newly developed gold fields of Georgia were represented and enough gold to start a national bank was pledged for the exhibit.

The Cariboo district will exhibit a brick worth \$42,000, representing a twenty-nine-day washup on one claim. French creek and Trail creek districts, which have been reported by prospectors engaged by Cecil Rhodes and Barney Barnato as being the richest gold fields in the world, will exhibit several carloads of rich ore.

The Canadian Pacific road, through its agent, Mr. J. F. Lee, promised several carloads of ore and quartz.

Letters were read at the meeting yesterday from mine-owners in Russia, China, Australia and Africa signifying their willingness to take part in the exhibition.

Several full-sized crushers will be in operation and also apparatus for extracting the gold from the quantities of placer washings which will be on hand. There will be working models of everything connected with a gold mine, from the most primitive wooden rocker to the latest magno-electric machine of chilled steel.

Quite a discussion was aroused at the meeting by proposals from G. E. Girling, editor of The Irrigation Age, and Mrs. Alice Houghton of the Chicago mining exchange to admit silver and copper to the exposition. The question was left undecided.

MONTANA CROPS.

WITH a crop of grain raised in the Gallatin valley last year amounting to two million bushels, the prospects for this year are an important consideration. The first few weeks in July were hot and dry, so that much grain suffered before it could be properly irrigated, and oats and spring wheat will show a slight decrease in the yield per acre over last year. Barley, however, looks well. Winter wheat

being raised upon non-irrigable land, the rolling bluffs surrounding this great valley, has been seriously scorched, and will probably show a decreased yield when harvested the latter part of August, which will be 25 per cent. below that of 1895.

Potatoes are looking well, while the hay crop is larger in acreage and in yield than ever before, having been so far advanced at time of drought as to be unaffected by it, and the part that clover will take in the hay crop exceeds previous years, with the quality excellent.

The average decrease in yield per acre here of cereals this year will be 8 per cent. below that of 1895, but a larger acreage should make the total in bushels a little above last year's crop. The prospects, therefore, are excellent in a general way; although individually not up to the average yield, will be appreciated.

P. C. WAITE,
Bozeman, Mont.

MUCH IN LITTLE.

It would be worth millions to Kansas if her fly-by-night farmers could be induced to emulate the postage stamp, which sticks to something till it gets there.—Hon. Edwin Taylor, address to Kansas Agr'l College.

Wages of farm labor are as high as ever, while household help is not to had at any price. This state of affairs seems to be general, yet the price of farm products was never so low. This thing has got to be evened up.—Orange Judd Farmer.

A telegram reached grain buyers last week directing them to pay only six cents for oats. This is the proposed prosperity under the McKinley regime.—O'Neill, Neb., Beacon Light.

In the language of the street, Nebraska is "strictly in it this year." J. M. Thurston was a central figure in the St. Louis convention. W. J. Bryan was the idol of the Chicago convention. W. V. Allen will be bellwether of the Populist convention. Bentley is the silver Prohibitionist nominee for the presidency. And Nebraska

will have the biggest corn on earth, this fall, too. In fact there isn't anything desirable in sight that she has not taken in.—McCook, Neb., *Tribune*.

Postmaster Hesing of Chicago says the present fight is "the proletariat against the plutocrat." Some time ago it was simply a craze that had died.—Ogden, Utah, *Standard*.

They call that man a statesman whose ear is tuned to catch the slightest pulsations of a pocketbook, and denounce as a demagogue anyone who dares to listen to the heartbeat of humanity.—William Jennings Bryan.

WHAT CONGRESS DID.

IN summing up the work in behalf of irrigation, accomplished at the last session of Congress, Senator Francis E. Warren of Wyoming writes that the finished work consists of:

Two appropriations amounting to \$54,500 for the gauging or measurement of the water flow of streams.

An appropriation of \$175,000 for topographical surveys.

An amendment to the so-called Carey law permitting the states to pledge their state selection of United States lands, under the 1,000,000 acre allowance, as security for the money or labor necessary to take out irrigating canals for the reclamation and preparation of the lands for settlement.

A provision (in the river and harbor act) that the United States Engineers shall examine and report upon at least one reservoir site each in Wyoming and Colorado.

Of the first mentioned, \$4,500 was appropriated in the annual Agricultural appropriation act for gauging streams, and \$50,000 in the sundry civil act. The gauging of streams is comparatively a new work. Some \$15,000 was expended for the purpose during the last fiscal year. While not entirely devoted to irrigation, yet quite a portion of the gauging work to be prosecuted under these appropriations will be in localities where irrigation is intended.

The appropriation for topographical work is in the sundry civil act, and is \$25,000 more than for the last year, and the act contains a provision that at least

two iron posts shall be erected in each township of six miles square of the public survey, erected as near township or section corner stones as possible, and bearing upon each a label showing the altitude above sea level.

The amendment to the Carey law is contained in the sundry civil appropriation act. It simplifies and makes applicable and practical the original law, which provides for appropriating a million acres to each state, to be selected by the state, and reclaimed through irrigation, for *bona fide* settlers, in tracts not to exceed 160 acres to each owner. Most of the arid states found difficulty under the law as first enacted in securing parties who were willing to advance the capital to construct the necessary canals without security (except the prospect of selling water rights to settlers). Hence, until titles were perfected, investors would constantly fear the absorption of the lands by settlers procuring them direct from the government under homestead and other acts, leaving ditch builders in the lurch. The indefinite language of the original act has made its interpretation by the Interior Department somewhat difficult, and has placed obstacles in the way of states securing the benefits which were originally supposed to be conferred.

A GLANCE OVER THE FIELD.

CALIFORNIA.

A vein of hard coal is reported as found nine miles north of San Jacinto.

The flow from the Eady tunnel near Ontario has been increased from 30 to 35 inches.

Orange county will have a good crop of walnuts this year, a product for which it is becoming famous.

The new cannery at Fresno paid only \$12 a ton for apricots and the farmers kicked vigorously thereat.

River gauges, such as have proved great money-savers in the Sacramento, are to be placed in the San Joaquin river.

The Hermosa Water Company has increased its flow of water six inches, and 5,000 feet of pipe has been put in to carry it to the irrigators.

White men are to be employed in the places of Chinamen in the celery beds of the Santa Ana valley. This is a settlement of a long pending conflict.

The crop of fruit for shipment now promises to be about an average with other years. There are few pears but an abundance of peaches and French prunes.

Quite a number of big hotels have been burned in Southern California within the past three years. Not one of them has been, or is being rebuilt.

A huge fruit distillery is being built in Fresno that will work up a large quantity of this year's crop which would not otherwise find a ready market.

F. M. Smith, of Oakland, claims to have completed negotiations in England for the development of his California borax mines and for the sale of its products.

The new city water system at San Jacinto is reducing the flow of the artesian wells below, upon which Lake View and other localities are dependent for a water supply.

The patronage in sight justified the proprietor of the new Casa Loma hotel, at Redlands, to remain open during the summer, instead of closing as was the original intention.

A gigantic electric company has filed its incorporation papers at Fresno, to develop power in the Sierra Nevadas and transmit it to Stockton—perhaps to San Francisco.

The Fresno Water Company is increasing its water supply by the boring of three additional wells, to accommodate increasing demands and the necessities of the Electric Light Company.

California canned asparagus is winning its way in the eastern markets and commands a ready sale and higher prices than the New Jersey product. It goes to market packed in both tin and glass.

The suit for damages by the Fresno Milling Co., against the Fresno Canal and Irrigation Co., asking damages for interfering with water supply has been decided in favor of the defendants.

This has been the hottest season ever known in the Colorado and Mojave deserts, the mercury ranging for days from 124 to 128 degrees. It is altogether too tropical for comfort.

The farmers near Banning are reported as having adopted a system in the cultivation of their lands which is proving eminently satisfactory. A man having a

hundred acres devoted to grain plants only one-half each year, giving the other half a rest and chance for recuperation. They claim that the crops are so much better the profit resulting is altogether in favor of this plan.

At the convention of orange and lemon growers at Los Angeles it was clearly brought out that the co-operative method of marketing is gaining favor, and it received a practically unanimous endorsement.

The "campaign" at the Chino beet sugar factory opened in the last days of July. There has been a larger planting than ever before and they are preparing for an output of nearly or quite 30,000,000 pounds.

The Southern Pacific Railroad company has purchased thirty-five acres of land near Cucamonga and have opened a granite quarry. The stone is said to be of extra fine quality, and the fragmental rock is to be used for ballast.

The Southern Pacific Railroad company has also purchased ten acres of land in East Riverside, which will afford ample room for the location of packing houses that will soon be needed for handling the crop from the extensive growing orchards.

The state tax levy this year is yielding a large excess of revenue, the governor having vetoed several of the appropriation bills. On the same valuation the rate can be reduced for next year from 65.8 cents to 48.5 cents on the hundred dollars.

San Diego voted by more than a two-thirds majority to issue \$1,500,000 bonds to purchase the Morena water system and to provide for the construction of a new city plant. The opponents immediately sued out an injunction and now the lawyers will have their innings.

John E. Kirk has planted 250 acres of hemp near Gridley and will give it thorough irrigation by pumping from the Feather river. He has the machinery on the ground for a complete hemp mill which will be in readiness by the time the hemp is ready to manufacture.

The Redlands Electric Light Co. is adding a steam plant as protection against accidents. It has been successful in every sense and has secured some very valuable contracts, which do not permit of a single

day of cessation in their performance. They are preparing against possible emergencies. There has never been any shortage of water, in fact there has always been a large surplusage.

This year's frosts have developed a number of thermal belts or districts which were exempt from them. There is such a variety of climate in the state that only the experience of a term of years can finally determine the best adapted localities for specific purposes.

The freight rates that are being established on the Valley road are but little more than half those which have been charged by the Southern Pacific company. Of course they will be met and may be cut to even a lower level than that indicated.

The dry season is proving a blessing in many sections by forcing a search for new water sources. A. B. Smith dug a well near San Dimas depot 35 feet deep which is yielding a large supply of water, steady pumping at the rate of thirty inches not nearly taxing its capacity.

The Colton Fruit Exchange paid its members dividends to the amount of about fifty thousand dollars for the shipments to the end of May. Several car-loads netted from \$900 to \$850 each and two cars of St. Michaels and Valencias sold for a gross amount of over \$1,300 each.

There are said to be more than a thousand bee-keepers in Southern California. Until recently there has been no organization and no means of ascertaining the extent of the product. Last year 7,000,000 pounds were marketed and the business is being extended northward into the San Joaquin valley.

Although the San Jacinto and Pleasant Valley Irrigation district is in the best condition of any in the state, the system is incomplete, and the pending decision of the Supreme Court of the United States as to the constitutionality of the law under which it is organized makes it impossible to dispose of the bonds necessary to its completion.

Judge Van Dyke has rendered a decision in the case of Mayberry against the Alhambra Addition Water Company of more than usual importance. It includes the declaration that developers are entitled to the increased flow of streams, even

after it has apparently passed from their control. The developer has rights that are paramount to the riparian claimant. The court refuses to recognize increased flow as a burden on riparian lands, as long as the accustomed flow is not diminished.

Mr. O. B. Stanton, formerly proprietor of the Baldwin Hotel, San Francisco, has been developing some mining interests in the Mojave desert and has struck a wonderful flow of artesian water near the Koehn postoffice. The well is six inches in diameter and is flowing water enough to run 100 stamps. It is now being utilized to drive a mill about 250 feet distant from it. This discovery is one of great significance in connection with the future development of that valley as to its agricultural and horticultural possibilities.

The San Francisco Wave eloquently discourses on the attractions of California—its ocean and mountains, the Yosemite and orange groves, the redwoods and Del Monte, and claims there is no land under the sun that can rival it either in the grand, the beautiful or the picturesque. Then it compares the commercial value of these with other products and states by way of illustration that New Hampshire plucks eight million dollars a year from the stranger visitor, or more than half as much as the total gold product of California.

The assessed valuation of Stanislaus county this year is \$13,167,459, a decrease from last year of \$1,535,447. It used to be that people were proud of an increase in county and state valuations, but it is so difficult now to pay taxes that they rather enjoy going backward.

The vintage of dry wines for 1895 was only 9,500,000 gallons as against from 15,000,000 to 24,000,000 per year during the past several years. The consumption within the state is about 5,000,000 gallons so that there is but comparatively little left for export this year.

Fresno is especially fortunate this year. The Republican says: "The advent of the Valley road, the introduction of electricity for power and light and the erection of one of the largest wineries in the state, show the great faith that capitalists have in the future of the county." And now there is to be added a large factory for seeding raisins. The machinery to be used has

been tested practically, and one factory is in operation in New York. The capacity at the outset will be two car-loads daily, employing ten machines, and it is expected that an enlargement of the plant will be necessary next year.

COLORADO.

Grasshoppers are causing trouble on the ranges near Golden.

Crops under the Larimer county canal are in splendid condition.

Many cloudbursts, some attended with loss of life, have been special features of this season.

The sheep sheared this year have averaged over seven pounds to the fleece in the dirt.

The apple crop is a little short in the Arkansas valley, about equal in loss to a good thinning. Other crops are up to the average.

There are 85,000 trees being watered under the Price ditch, in the Grand Valley this year, of which 75,000 have been planted this year.

The Farmers' Protective Association, at Evans, has brought suit to recover \$50,000 of damages from the ditch companies on Clear creek for taking water that does not belong to them.

The ranges in southwestern Colorado and northwestern New Mexico have suffered fearfully from drought, and thousands of cattle had to be shipped out to save them from starvation.

The Monte Vista Journal says the losses through shortage of water this year will amount to more than it would cost to build the necessary storage reservoirs on the upper Rio Grande to insure an ample supply at all seasons.

Smith & Struthers have completed their gravity ditch through which they flow the water from Plateau creek, across the Grand river to the plateau above Grand Junction, thereby bringing under cultivation a body of extra choice fruit lands. It will require the balance of the season to fill the ditch with water and get it into good working condition, but it will be ready for full operation next season.

The severity of the drought in some portions of the West is well illustrated in the records of the Poudre river, which have been accurately kept for a number

of years. The average flow for the week ending July 14 was 417 cubic feet per second. In 1895 for the corresponding week it was 1,408 cubic feet, and for twelve years previously the average has been 1,336 feet per second. The lowest record previously was 484 feet in 1888.

The Mancos Times says the drought has given the ranchers a new wrinkle in alfalfa raising. Heretofore they have used too much water, making the ground soft and the roots of the plants so tender that even a light wind would topple over whole fields before it was ready for the mower. Authorities at the State Agricultural College maintain that too much water is ordinarily used, and that the grass should be cut before it has fully blossomed.

IDAHO.

There was an active demand for the Snake river cherry crop, and the harvest was hastened by it.

There is a rock found along the upper Snake river which has been used to some extent for building. When first quarried it is soft and can be sawed into blocks of almost any size with little labor. It is so light that a man can lift a yard cube block of it. It will not stand fire, but it becomes very hard when exposed to the weather. It is of three colors, gray, white and pink.

At Boise, hot artesian water is piped from the foot-hills and is used for heating many of the largest buildings. They are now sinking a well which is down four hundred feet at the government army post, and if they succeed in striking the heavy flow, as anticipated, it will save \$400 a year in fuel. If the post is increased to a regimental headquarters, the saving will amount to over \$10,000 a year.

KANSAS.

The Kaw bottoms, between Lawrence and Kansas City, have 11,000 acres in potatoes this year, with the promise of a splendid crop.

Farmers in the Arkansas valley are suffering loss of crops again this year because of the shortage of water in the river. There can be no effective remedy except to store the flood waters, and the sooner the people get about it the better it will be for them.

Judge Fred Wellhouse, of Leavenworth county, is the most extensive and most successful individual apple grower in the United States. He has 1,360 acres, planted during the past twenty years, and is adding 160 acres this year.

The yield of wheat this year is expected to be about 43,000,000 bushels, or double the crop of last year. The home consumption is supposed to be about 9,000,000 bushels, leaving about 34,000,000 bushels for export, or 10,000,000 more than was exported from the Argentine last year. If it was worth fair prices it would make prosperous times for Kansas. As it is the people will work hard and the railroad companies will reap the principal benefits.

MONTANA.

All crops are fine this year in the western part of the state.

Billings has a new flouring mill of the best modern pattern. It is one of the several recently erected in the state, and all of the same class.

Two men at Terry sheared 462 sheep in three minutes less than ten hours, and won a wager of \$100 that they could turn off four hundred head in that time.

NEBRASKA.

Several thousand car loads of grain from this and adjoining states have already been contracted to go out over the Missouri, Kansas and Texas road via the deep water harbors of the Gulf to New York and Europe.

It is said that P. D. Armour has put an expert buyer in the Omaha market who is buying all the sheep offered of every description, and the query is, what is the significance of it? Armour does very little business for fun.

The Nebraska Farmer claims that the state will have the largest and best crops of all kinds ever grown there, and it proposes to hail the advent of returning prosperity by the issue of a 32-page Stand-up-for-Nebraska edition early in August.

Rapid progress is being made on the Great Eastern canal. It is intended to irrigate 250,000 acres in Nance, Platte and Colfax counties. Five grading machines and fifteen scrapers are at work on the main canal, and five miles are completed.

The power and irrigation canal at Crawford is nearing completion and water has already been turned in. The people of the town are greatly elated over the bright prospects before them and give credit that is due to Mr. Chas. J. Grable, through whose public spirit, energy and perseverance the work has been accomplished under unusual difficulties.

Thousands of wind mills and pumping plants are being erected for the purposes of irrigation. The same outfit provides for many other important purposes. The water may be run through the creamery box, thence through the watering trough in the stock yards, thence to a reservoir where ice may be cut, to another one where fish are grown. Indeed there are many uses to which the same water may be applied before it is finally turned upon the soil.

NEVADA.

People of the Carson Valley are earnestly considering the matter of water storage in that valley, where a large area of choice land can be made available at a moderate expenditure. A series of fourteen small reservoirs is proposed that will cost about \$100,000.

NEW MEXICO.

Wolves are killing many calves in Lincoln county, and the stockmen are rising in arms against them.

Ground has been broken for the Sisters' New Sanitarium and Hospital at Las Vegas. It is under contract, to cost a little more than \$20,000.

Cattle men in the southern part of the territory report the increase this season as better than at any time since the '80's. The outlook for a prosperous year is very bright.

M. W. Mills, the pioneer orchardist of Colfax county, is erecting a canning and preserving factory to utilize great quantities of fruit that he cannot afford to haul thirty miles to market. It will have a complete modern equipment of machinery.

The Pecos Valley people have acted wisely in securing the advice of experienced men for the beet growers in that valley. Mr. Austin, who as superintendent of the farm operations for the Lehi, Utah, company was down there for three or four weeks. No better adviser could well be

found if success for a term of years counts in a man's favor. He was followed by Mr. M. E. Johnson, of Chino, California, another recognized expert.

The capital having been raised for the construction of a great reservoir on the Rio Grande river, above Rincon, and a system of canals for all the valley including the cultivated lands in Mexico below El Paso, it is thought there will be no occasion to construct the proposed international dam. The new company will furnish the Mexican people with water on better terms than they expected to get it from the government project, and it saves from overflow a large body of choice lands that can be utilized for cultivation and that will be immensely enhanced in value.

The wool growers' convention at Las Vegas formulated a report with accompanying resolutions, in which it is claimed that since 1890, under existing legislation, the average value of sheep has been reduced from \$2.66 to about \$1.00 a head and the price of wool has been lowered as much as 60 per cent., so that the loss in both wool and sheep has been about two-thirds the former value. For the fiscal year ending June 30, 1894, the wool crop was about \$3,000,000 in value, while for the fiscal year of 1896 it is not more than \$500,000. The loss resulting to the territory from the present tariff act has been \$6,000,000 in the value of the sheep and an annual income of \$2,500,000 in the wool product. Naturally they are interested to have a change in the legislation which produces such results.

NORTH DAKOTA.

Hon. Walter Muir expresses the opinion that wheat will not average nine bushels to the acre in this state.

An artesian well on the Howard farm, near Forman has been finished, 880 feet in depth. It throws a $4\frac{1}{2}$ inch stream of water 16 feet in the air and has a pressure of 125 pounds to the square inch.

The Northwestern Farmers' Protective association acknowledges failure to accomplish its purpose and has decided to dissolve the organization. It will require an assessment of 25 per cent. on the stock to pay the indebtedness.

OREGON.

The Albany creamery was compelled to decline an order for 8,000 pounds of but-

ter, having orders in hand for 21,000 pounds not yet filled.

SOUTH DAKOTA.

J. G. Bullen of Ashton, South Dakota, has an artesian well flowing 600 gallons a minute. It is about 1,000 feet deep and cost less than \$1,000. The water will be used to irrigate a large area of ground.

The successful operation of the Hunter farm at Mellette is proving a very great object lesson to those interested in irrigation and as a result a large number of farmers have been irrigating this year, and next year the farmers who depend on rainfall will be in the minority.

UTAH.

Kaysville has completed its second reservoir, holding 10,000,000 gallons.

A heavy cloudburst at Mercur, July 7th, did considerable damage, washing out the streets and flooding the store rooms.

The state will soon receive \$22,000 from the general government to go to the fund for the College of Agriculture and Mechanic Arts, the amount having already been audited.

Out of the appropriations for surveys made by the recent Congress the U. S. Surveyor General for Utah will have \$20,000 at his disposal for surveys of agricultural and grazing lands within the state, and he has called for applications for survey from the citizens so as to use it to best advantage.

The survey of Gunnison Island in the Great Salt Lake has been approved by the commissioner of the general land office, and a plat has been filed by the Surveyor General in the land office at Salt Lake City. It is said some portions of the island are very desirable.

A suit which will raise the question of priority of water rights on the Provo has just been begun by way of injunction against the people near Woodland, who have been using during the past six years a full water supply without regard to the claims of the Wasatch and other companies above them, which were first established. There will be a bitter contest, as there are important fundamental questions involved.

WASHINGTON.

Great crops and lots of work to do, but low prices yield little return for the labor.

The Spokane Chronicle don't want to see the state crowded in European fashion, but thinks there is ample room for 200,000 more people with some money and lots of hustle.

Chinese thistles are getting too much of a foothold in and around Spokane. People are too busy talking politics to devote time for their extermination.

WYOMING.

The lamb crop is unusually good this year.

Big Horn county was formally organized July 6.

The first pot of cement was calcined at the new works at Laramie early in July. It is pronounced to be of very superior quality.

Robert Taylor, of Caspar, has a wool clip this year of 560,000 pounds. He is supposed to be the largest individual wool grower in the country.

The Rock Creek coal mine owners are trying to induce the government to purchase its supply of coal for the Pacific coast coaling stations, instead of going to British Columbia for it.

Cloud-bursts, several in succession, have so damaged the Brockway ditch, near Douglas, that it may have to be abandoned for the year. A soaking rain soon afterward saved the crops from total destruction.

The largest sale of state lands yet made was at Evanston recently when lands which have been occupied several years under lease were sold at auction to the occupants for an aggregate sum of \$4,335, which goes to the state school fund.

Some mischievous or malicious person cut the locks on the headgates of the new Cody canal in the Big Horn basin, raised the headgates and let a big head of water into the canal, which was not yet well set and ready for it. A break was the direct consequence and a great deal of damage to farms below the canal.

One geological survey party has left Sheridan to triangulate across the Big Horn range into the basin, and another party left simultaneously from Red Lodge, Montana, carrying levels into the same basin and prepared to make a thorough topographical survey, the two parties co-operating. It will materially

assist the settlement of that great basin of rich land in Northern Wyoming.

AN ERROR.

In Mr. C. C. Hutchinsons' article on "Growing Winter Grain", in the July number there is reference to his work entitled "Resources of Kansas, or Fifteen years experience." A typographical error made this appear as though published in 1891. The correct date is 1871 which is twenty years earlier. Mr. Hutchinson was one of the very earliest of Kansas pioneers and the thriving city of Hutchinson was named in his honor.

PRACTICAL POINTS.

Clean out your granaries and destroy the vermin of every kind before putting in new grain.

Sheep and fowls are the gleaners of the modern farm; they save much that would be wasted without them.

A hen that does not work for a living never amounts to much, no more than a man.

Motherhood in its largest development is the object sought in the profitable dairy cow.

Because poor cows will yield no profit is no reason why good cows will not pay.

Pure water is as important as pure food to any kind of live stock.

Nothing on the farm should be under so complete subjection as the weeds.

There is less danger of producing things too good than not good enough.

It is claimed that cows with thick udders usually give rich milk.

Hay is most nutritious as feed when cut before the seed begins to ripen.

Breed for heavy weights in horses, no matter if a ton.

A change of food is sometimes better than more food.

It is as unprofitable to feed too much as too little.

It is pigs that are wanted in the markets now—not hogs.

You must begin in the stable to make good butter.

Feed, as well as breed, is necessary to dairy success.

MACHINERY AND APPLIANCES

THE AUSTIN CURRENT MOTOR.

THE name "Current Motor" is applied to a mechanism that utilizes the power of the stream or current of a river in such a way that it can be applied to operate machinery. Several crude attempts have been made in the past to accomplish this,

the construction and maintenance of the dam, and was only available where the conditions were favorable, which necessarily very much limited their use. The current motor, however, can be used without a dam, in any river, in any location in the river where the water is deep enough to admit it.

AUSTIN CURRENT MOTOR.

and the F. C Austin Manufacturing Company, fully appreciating the advantages and possibilities of generating power so cheaply, have invented and placed on the market a practical current motor.

Rivers have been utilized to run machinery by damming them and using a water wheel, but this necessitated the expense of

There is almost no limit to the use to which the power generated by a current motor can be applied. For example, it may be used for generating electricity for electric lighting purposes, and for various machines used on a farm now run by steam, but its chief use will be in connection with irrigation and mining.

There are many localities in the West, and in fact all over the country, where the land adjacent to the river is too high to admit of the water being conveyed to it through ditches by means of gravity. Under such conditions the land is now generally not irrigated, particularly in the arid regions, except to a limited extent in those localities where vegetables and fruit are raised, where the value of the crop compensates, in a measure, for the expense of pumping water by steam or gasoline engine, both of which require fuel and an engineer. The capacity of the windmill is too limited to admit of its general use for irrigation on a large scale. To such localities the Austin Current Motor will prove a boon.

This motor has been experimented with and tested thoroughly and its practicability practically demonstrated. The only limits to the power, and consequently to the amount of water that can be pumped by the Austin Current Motor, are the dimensions of the paddles, the number of them and the force of the current.

The machine, which is anchored in the river, consists of a pontoon carrying two endless chains, to which are pivotally attached, at suitable distances, reversible paddles having floats at their upper ends that buoy them up in their course through the water. By an ingenious device these paddles enter and leave the water in such a way that they do not detract from the efficiency of the machinery, but on the contrary rather add to it. To the wheels put in motion by these cables is attached an elevator carrying large buckets, which, when entering the water to fill themselves, add to the generation of power, and are so arranged that when they reach the top of the elevator they discharge their contents with the least possible friction into a trough, there to be conveyed to the shore, where a reservoir has been constructed to collect the water and distribute it through canals and lateral ditches over the land.

The first outlay for a current motor of this description is, comparatively speaking, not large, particularly when the enormous enhancement of the value of the land is considered, and the cost of running it is nominal. It works incessantly, day and night, without an attendant, and if the capacity of the reservoir is sufficient, a large volume of water is accumulated to be used at the proper season.

For full particulars, write to the manufacturers, the F. C. Austin Manufacturing Company, of Chicago, Ill., U. S. A.

LAND GRADING.

The Shuart Land Grader, the cut of which in our advertising columns has become so familiar to the readers of the *Age*, is eliciting much hearty and enthusiastic praise from a widely scattered and diversified class of patrons. The accuracy and economy with which grading for irrigation can be accomplished with this machine is a happy surprise to each new purchaser.

The Shuart Grader has come to be recognized in the East as exceedingly convenient and useful for road and street purposes. In this sphere it is designed to supplement rather than to supplant the big road machines in general use, and so popular is it for this purpose that it is being purchased by townships in numbers varying from a single machine to one machine for each road district in the township.

In no sphere has its success been more marked, however, than in the preparation of the sub-grade of streets for pavement. Hitherto this work has been done by hand labor with picks and shovels, at great expense, as there has been no scraper made with which the sub-soil could be planed down with sufficient accuracy. The following testimonial, which is by no means an unusual one, shows the great value of this machine to street contractors:

COLUMBUS, Ohio, June 6, 1896.

B. F. Shuart, Oberlin, Ohio.

DEAR SIR: We beg leave to testify to the merit of your Shuart Land Grader. It has more than saved its price within the first four days' work, having used it on the finished sub-grade, in which capacity it has each day saved the expense of from ten to twenty men, with just the same or better results. We find it extremely handy and useful.

Very truly,

KINNAR & GRAHAM.

Important improvements have recently been added to the machine.

In 1895 there were eight hundred and fifty-five creameries in Iowa. Only four of the ninety-nine counties have none. The total output was \$13,300,000, an average per factory of \$15,555.

PRICE, 10 CENTS.

SEPTEMBER, 1896

\$1.00 A YEAR.

VOL. X.

No. 3.

WHAT THE FIFTH CONGRESS SHOULD DO.

VAN DYKE ON PRACTICAL IRRIGATION.

112 DEARBORN ST., - CHICAGO.

Spiral Riveted Water Pipe.

3 TO 24 INCHES IN DIAMETER. 2 TO 25 FEET LENGTHS.

...FOR...

Irrigation, Hydraulic Mining, Water Works, Stock Ranches, Etc.

Connections and Fittings to Suit Service Required.

ABENDROTH & ROOT M'F'G CO.,
28 CLIFF ST., NEW YORK.

VICTOR TURBINE WATER WHEEL.

UPRIGHT OR HORIZONTAL.

The attention of *Irrigation Companies* is called to this **CELEBRATED WATER WHEEL** as particularly adapted to their use, on account of its *remarkably steady Motion, high Speed and great Efficiency and large Capacity*, for its diameter, being *double the Power* of most wheels of same diameter. It is used by a number of the leading *Irrigation Companies* with great satisfaction. In the economical use of water it is without an equal, producing the highest per cent. of useful effect *guaranteed*.

THE SMITH-VAILE POWER AND STEAM ELECTRICAL DRIVEN
PUMPING MACHINERY.

SEND FOR CATALOGUE AND PARTICULARS.

THE STILWELL-BIERCE & SMITH-VAILE CO., DAYTON, O.

Rife's Automatic Hydraulic Engine

WATER SUPPLY FOR SMALL TOWNS; WATER-WORKS; RAIL-ROAD TANKS IRRIGATION; COUNTRY RESIDENCES; ETC.

An entirely new application of the Hydraulic Ram principles. Large Air Cushion, positively air-fed at each stroke, insuring ample air cushion. Constant Action! Never Stops! The Double Acting Engines pump potable water by impure water without pollution or use of diaphragm. Efficiency very high. Will elevate water 25 feet for each foot of fall. Capacity up to 150,000 gallons daily. Flattering Award at Columbian Exposition.

Send your conditions of Spring, Stream or Flowing Well for guaranteed estimate. Catalogue free if you mention The Age.

A Rife Ram at work Irrigating, etc.

TABLE OF SIZES AND PRICES.

	No.	Size of Drive Pipe	Size of Delivery Pipe	Gals. per Min. Required Under 5 to 7 Feet Fall	May be Regulated to Use Per Minute	Least Feet of Fall Recommended	Weight	Price, Single-Acting	Price, Double-Acting
Engine	10	1	3/4	4 to 5	2 1/2 to 3	5	125	\$50 00	\$65 00
"	15	1 1/4	3/4	6 " 12	5	3	150	55 00	70 00
"	20	2	1	8 " 18	7	2	200	60 00	75 00
"	25	2 1/2	1	10 " 24	11	2	225	66 00	81 00
"	30	3	1 1/4	15 " 35	15	2	250	75 00	90 00
"	40	4	2	35 " 75	30	2	350	120 00	140 00
"	50	8 or 10	4 or 5	150 " 350	150	3	3000	450 00	500 00

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Mention the IRRIGATION AGE.

THE IRRIGATION AGE.

VOL. X.

CHICAGO, SEPTEMBER, 1896.

NO. 3.

PUBLIC OPINION AND THE IRRIGATION CONGRESS.

NO one more fully appreciates the attitude of THE IRRIGATION AGE toward the great question of reclamation of the arid lands of the West than I do. THE AGE, ever since its birth, has advocated a national policy broad enough to include plans for the reclamation of our arid plains as well as the uplifting of humanity at large. The policy advocated has been too broad, too generous, and therefore impracticable. This work, I believe, is too great for our civilization; our institutions are too corrupt. At present they will not aid us to take up this work in the most local manner.

There seems to be an invisible but all-powerful force at work whose sole purpose is to defeat any and every measure which has for its object the "greatest good for the greatest number." "Private enterprise" must not be discouraged, even if it is busy in the work of overthrowing our republic.

At times during the past five years our unemployed have numbered millions. The misery of the poor in our cities surpasses that of Europe's most degraded. A Medici could not have been more corrupt than the heads of some of our own city governments. We are taxed to build battle ships at a time when the whole world never had better reasons for maintaining peace, and the price paid for one such battle ship would, if expended in watering lands of the West, provide homes for a hundred thousand people. When Congress, like the press, is the mouthpiece of corporations and trusts; when the people are taught that "paternalism," or the public ownership or control of monopolies, threatens the liberty of the nation, and that *private* ownership of the planet itself

is preferable; when we, with all our boasted facilities for the expression of the will of the people, are a quarter of a century behind civilized Europe in modern reform; we have but little reason to expect the federal government to aid in any work which might carry with it a blessing to humanity.

Let us turn from the impossible chances of federal aid to opportunities of taking a step forward through state influence. The people of this state (Idaho) are preparing for a contest to be settled in November. For what purpose? For the inauguration of some prearranged state policy of development? for the strengthening and building up of state institutions? We have not had a state policy outlined for years. This contest is being entered into simply for office. The old parties are now torn into factions, and men, through their partisan zeal, have lost sight of the state with its future. This occurs periodically, and the meetings of our legislatures are remembered as marking the disgusting contests for public office. The *event* of a session is the election of a United States Senator; all other acts are subordinated to this great undertaking, for which preparation is begun at the people's primaries, and work prosecuted to the detriment of all needed legislation through the "trades," "compromises" and "combinations" made by members, until worn out or bought out, a small faction gives in, and the greatest of all the gifts of the people, next to the presidency, is won by a man who had the ability to "get there," and the legislature adjourns. We have reached a condition where a good, clean, honest government would be an innovation.

Those who *will* think, believe we are now

feeling the first pulsations of a great national upheaval. We know that all appeals for national aid in the work of reclaiming arid lands fall upon deaf ears. Our state legislature cannot be induced to pass a sensible resolution on the subject, so absorbed are they in the welfare of men ambitious for national honors. I feel safe in predicting that for the present nothing will be done by either state or nation in this matter. Let us wait until our present pressing troubles have been overcome, until the great period of reconstruction is upon us, then we may inaugurate a policy of development as broad and generous to the masses as that pursued by the Incas of Peru. *We are barbarians!*

Just now we have thousands of acres already watered crying for occupants, we have, as have other states, plenty of broken down irrigation companies, and under the present disorganized condition of public affairs I neither hope nor care to see the prosecution of new enterprises until the ones already perfected are upon a paying basis, and under every canal a contented and prosperous community.

The Irrigation Congress of the future, in order that it may be a potent factor in the work of reclamation of arid lands, must direct itself to *state* issues, for through the example and influence of the "arid states" will follow all *national* aid and blessings.

Why should we ask Congress to do more than *we* are doing? We, who have been on the ground for years and appreciate the importance of the work and the great blessings which would be sure to follow the development proposed.

We should all pray God that the rotten methods of administration, that the spirit of corruption which seems to pervade the very sanctuary, the place where law is given birth, might have passed away, and that a broad, generous public policy, embracing the best interests of the *common people*, might be the order of the day before the great rivers of the West are poured out upon the deserts and started upon the work of *redeeming more bonds*.

Before these great canals are built by the national government our national policy will have undergone a complete change, for the work of building must go hand in hand with the work of relieving suffering humanity. These canals must belong to the people *who use them*, and under them millions will find homes, and the work,

when completed, will stand as the greatest monument to an enlightened nation.

An enduring monument must have a broad base and a firm foundation. We must therefore first clear away the prejudices of the times due to past errors, dig through the rottenness of to-day down to the first principles of sound government, and upon this foundation, and this alone, erect a structure from whose highest pinnacle prosperity shall proclaim peace and happiness to all who labor in the sunny "arid West."

D. W. Ross.

Payette, Idaho, August, 1896.

NONE of us have any time to cavil or complain over what has been done or has not been done by any member of the association. There is no time for any paper or magazine to criticise others or their work in the cause.

We are all for the same objects and it matters not whether we be the "hare or the turtle in the race." Both will get there just the same. The slow turtle may be the quicker because it does not stop to see or ask what others are doing.

It is not the breezy, gauzy, voluminous continued articles that are always appearing in the press, to the satisfaction of the writer and to the great disgust of the public, that do much good.

The members of the executive committee of the National Irrigation Congress are, and will continue, doing their duty, notwithstanding any remarks to the contrary. They are men of ability and are practical, energetic, pushing business men who believe that there is a time and place for all things, and when the time comes for each to push it to the front they will with all the manly vigor and strength and power within them, making a complete success of it; not consuming too much time in its development but just enough to keep the anxious public on tip-toe as to what comes next. They believe that in direct, continued and united effort, more can be accomplished in three months' time before the congress than to string it out in a flimsy way for twelve months.

The work of the committee this year will be found as great as any other year—wait and see!

It is true that not many conventions have been held and especially in the

northwest (have there ever been any that the National Congress called through its executive committee?), simply because there were no funds. And the committee soon found that there would be none or would be very small if any. For those who had given as individuals or corporations wanted an accounting of it before more would be contributed. Again it has been and is the dearest year that this country has seen since the war, so much so that it has not only paralyzed business of all kinds, but it stupefied the people and produced that "don't care" way about them that no one or ones could arouse that enthusiasm that is needed in all meetings of this sort. The fact is, the people don't care about so many meetings. They know what irrigation means. They feel the need of applying it and many are applying it to their needs. What they want is the enactment of proper laws for the distribution and use of water, for the greater development of the arid and semi-arid west, in such ways and by such means as mainly will be expressed and determined upon by this coming Congress. They will formulate these into bills that will be presented to the next congress of the United States for passage. Now, what bills do you want to pass upon? This is the main question! Let every one in every state and territory interested in this great cause, express himself through the columns of *THE IRRIGATION AGE*, and come prepared with his bill ready for consideration before the next Congress. In other words, let us resolute less and legislate more. Let us definitely decide upon what we want as a Congress and then press forward to its accomplishment. Let us depend less upon committees to do this work that must be done by the Congress. For four years we have talked and resolved, held meetings and been entertained by the brainiest men in the work, have been benefited in many ways as an individual, toasted and banqueted from place to place and from coast to coast. Now let us boil down, crush out and wash out all the dross and crystallize all the bright practical thoughts and sayings into bills that will be of permanent good to the cause of irrigation and finally the country we seek to benefit.

Now, you want to know what has been done by the committee, and what we think should be done at the next Congress? You

shall know, if from now on to the meeting of the next congress, you watch the papers and read what is said about irrigation and the Congress at Phoenix.

E. R. MOSES,
Chairman National Executive Com.
Great Bend, Kan., Sept. 7, 1896.

AS a member of the Fourth Irrigation Congress, at Albuquerque, N. M., in 1895, I am clearly of the opinion, from experience gained at that session, that the work of the coming Congress to be held at Phoenix, Arizona, next December, should be outlined by the executive committee and by our irrigation publications. It is not saying that in the past the work was not outlined, writers and speakers notified to be prepared on certain subjects, etc., just as is now suggested by the present executive committee, but what we now desire to call special attention to, is to prepare the Congress for vigorous and telling legislation upon the practical propositions that will come before it. In the various "Addresses to the Country," as adopted by each Congress, now for four years, we have asked for "legislation suited to the peculiar needs of this (arid) imperial domain." We have declared "that it should be the policy of our National Congress to frame laws which will enable the people to obtain possession of the arid public lands." We have asked for "forest reservations; for the education of skilled foresters; for the application of the 'Carey Act,' to various states and territories." We have asked for legislation and the appointment of commissions looking to the adjustment of the difficulties arising out of the waters of interstate and international streams.

As we have done all this; resolved, declared, and demanded, the interrogation will be put—What can we do? That is the question. What can we do as a convention, formed, as this Congress will be of representative, practical irrigationists, representing the most prominent and important industry now before us as a great nation, with thousands of families in our great cities and centers of population, destitute, and demanding the opportunity of making a livelihood. We have millions of acres of as rich and productive soil as the prairies of Illinois or Iowa can boast of, now lying idle, in what is called arid

wastes of the middle west. Contiguous, and available to these same arid lands are catchment basins and reservoir sites capable of impounding the summer rains and winter snows which a kind Providence sends upon the just and unjust alike, sufficient for the thorough irrigation and reclamation of these lands. Many of these reservoir sites have been located by the government under act of congress of Oct. 2, 1888.

We have asked the general government to appropriate money and appoint commissions, and under their supervision, to expend this money so appropriated, to make available these reservoir reservations. We have represented, that by this course thousands of happy homes will be made on what are now desert wastes, inhabited only by the rodent and the reptile. To all of these reasonable demands, the national congress has paid no attention. By recent decisions of the Interior Department, the act of March 3, 1891, relating to reservoir reservations, has been declared defective and inoperative, so that these reservations cannot be utilized as was intended, and therefore these waters are running to waste, creating floods and inundations in the settled valleys below, and the lands which should receive the benefit are still waste places. As the general government does not show a disposition to put into operation the laws now enacted and make available these reservations, let the coming session of the Irrigation Congress recommend that these reservoir reservations, segregated and set aside by Act of Oct. 2, 1888, be turned over to individuals, companies or corporations, under the proper restrictions, who will submit plans of their proposed work, and who will put in the necessary capital to impound these waters and subserve the general purpose for which these segregations were made, and thus carry out the real intent of the government. Private capital is abundant and anxious for good investments. Irrigation enterprises, based upon sufficient water and good land upon which the water can be placed, are considered good investments. The "dog in the manger" principle, upon which these reservoir reservations are now held by the general government, is working untold injury to thousands of people who make up our best communities and who, if opportunity was offered, would settle up our desert lands, build school

houses, churches, and erect happy homes.

Should our national congress take this view of the present situation of these reservations, private capital will set the initiative, construct reservoirs upon certain of them, thereby illustrating in an object lesson the feasibility of the enterprises, after which, when the government gets ready to act, the remaining reservations can be withdrawn and the proper authority take it up.

This character of work appears to me to answer the query at the head of this article. There are other equally good propositions which might be enumerated for the coming Congress, but I fear I have already too far trespassed upon your space to give them this time. I will only add, that our experience shows the necessity of immediate practical national legislation to redeem our arid lands and give an impetus to the agricultural interests of the great middle west of greater importance to us than the great question of 16 to 1 now so much agitated.

J. S. VAN DOREN,
Bluewater, N. M., Sept., 1896.

I AM, after an experience of eleven years on this portion of the American Desert, convinced that the land laws governing the settlement of the Mississippi valley, ought not to apply here. I am sure that if settlers could have taken 640 acres each on long time, at say, 3 per cent. interest, we would have a considerable population now, if the pre-emptors had had ten to twenty years to pay in and no proving up and mortgaging in less time.

I am in favor of a classification of the western lands into first, second and third class irrigable, owing to their fertility and ease of irrigation, and the non-irrigable classed same way, their value being settled by their grazing value. The taker of an irrigable claim to have a dry section or two as well.

The object being to give men land enough to make a living on and acquire it at a low price, on long time and low interest. Better give the public lands to the states as they are admitted to be states. Secondly, I decidedly favor the opening of the Indian reservations, providing bountifully for each Indian family in land. Thirdly, If the lands cannot be turned

over to the states, I decidedly favor the extension of the Carey law to all states and territories in the arid regions. I also think it entirely proper that the government should return a good share of the money collected from the deluded settlers west of the 98th meridian. This money to be used in surveying and building reservoirs and otherwise aiding irrigation. With the exception of small sections here and there, all of this great territory in the arid region is better adapted for stock purposes than anything else. And the most of the irrigation in a vast deal of this region will be done to raise crops to safely carry on the stock business, as an aid to it.

We have our regions specially adapted to some one thing. Louisiana for sugar, the South generally for cotton, the Mississippi and Missouri valleys for corn, the Northwest for wheat, and, as our population increases, this region will be one vast grazing ground for cattle and sheep. Laws should be made, placing these lands in the hands of the people, having in view the uses it can be best put to. And who can make such laws better than the men living in the states of the arid region. So let the government go out of the land business and by so doing these new states can lease their unsold lands and thus benefit their public schools and mature plans on the ground for the building of canals and reservoirs, and I believe a vast growth of population and increase in wealth would result, in much shorter time than if this region is dominated by land laws, made by eastern men unfamiliar with our conditions.

C. D. PERRY.

Englewood, Kans., Aug., 1896.

I AM in favor of the repeal of the desert land laws. I am not in favor of opening the Indian reservations at present. I think it would be but justice to the territories to give them the benefit of the Carey law. Government reservations ought to be given, leased or sold to parties who will make the best possible use of them for the public, if the government will not make use of them itself.

I approve of the government making speedy surveys of available water supply for irrigation and the construction of storage reservoirs. The matter of state laws to protect actual settlers and to prevent dishonest bonding was very generally discussed at both the National Irrigation

Congresses I attended and resulted mainly in developing the fact that there were as many different views upon the subject as there were speakers. It is a vexed question under our present system of governmental management of waters. I know of no system that meets my views equal to that in use in Canada. The more I study the question of irrigation the more I am convinced of two facts. First, that our government is neglecting one of its best opportunities to build a republic that will be as enduring as time. Second, that we have no statesmen to-day of a broad, far-reaching, comprehensive character and ability to grasp and carry on this work.

A. L. KELLOGG.

Rocky Ford, Colo., Aug., 1896.

THE government should exercise the same care and prudence in the disposal of its domain as would a private individual. The government has no moral right to dispose of public property by gift to private individuals, while, unfortunately it has the power.

The importance of proper construction of dams to make reservoirs is so great that it should be undertaken by the government only, while the users of the water from such reservoirs should be required to pay such charges as might seem proper, so that the investment of public moneys should be made revenue producing.

No bonding schemes of any sort, no investments of private capital in irrigation works of a general character should be permitted under any circumstances.

The desperate financial condition of our people is due to a large extent to the enormous interest charges that we are carrying and every man who has the interest of his country at heart, should frown on all efforts at extensions of this most pernicious system. GEO. M. MUNGER.

Eureka, Kans., Aug., 1896.

I FEEL that we are not at present needing more land opened to settlement; that the government after selling land to innocent purchasers and representing it as a place to make a home and furnishing nothing but the most meagre information concerning it, owes to its subjects a full, careful survey that will disclose accurately all its possibilities and advantages.

J. S. BARNES.

Pratt, Kans., Aug., 1896.

The Fifth National Irrigation Congress

To the People of the United States of America:

Pursuant to the order of the Fourth Irrigation Congress and to designation by the National Executive Committee, the Fifth Annual Session of the National Irrigation Congress will be held in the City of Phoenix, Arizona, upon the dates of December 15, 16 and 17, 1896.

The membership of the body will be made up as follows, in accordance with the resolutions of the Third and Fourth Congresses:

BASIS OF REPRESENTATION.

1. All members of the National Executive Committee.
2. All members of State and Territorial Irrigation Commissions.
3. Five delegates at large, to be appointed by their respective Governors, for each of the following States and Territories: Arizona, California, Colorado, Idaho, Kansas, Montana, Nebraska, Nevada, New Mexico, North Dakota, Oklahoma, Oregon, South Dakota, Texas, Utah, Washington, and Wyoming.
4. Three delegates at large for each State and Territory not heretofore enumerated, to be appointed by the Governors of said States and Territories; or, in the case of the District of Columbia, by the President.
5. One delegate each from regularly organized Irrigation, Agricultural, and Horticultural Societies, and Societies of Engineers; Irrigation Companies, Agricultural Colleges, and commercial bodies, such as Boards of Trade, Chambers of Commerce, etc.
6. Duly accredited representatives of any foreign nation or colony, each member of the United States Senate and House of Representatives, and each Governor of a State or Territory will be admitted as honorary members.

THE WORK OF THE IRRIGATION CONGRESS.

The work of the National Irrigation Congress has now continued for more than five years. The first session was held in the City of Salt Lake, Utah; the second in Los Angeles, California; the third in Denver, Colorado; and the fourth in Albuquerque, New Mexico. Each session was marked by keen interest and by intelligent and effective work in the cause of irrigation and the reclamation of the arid lands of the West.

THE FIFTH ANNUAL SESSION.

The coming session at Phoenix will, it is not doubted, be the most effective of all. Particularly prominent will be made the discussion of points of legislation in order that well-digested measures be prepared for the consideration of the Federal Congress and of the State Legislatures. Though able authorities will be in attendance and have been placed upon the programme for the presentation of subjects of technical and economic interest, it is designed that the Fifth Congress shall be a body with work far more general than has been the case in any of its predecessors. Addresses presenting subjects shall be limited to fifteen minutes, and the subsequent discussion to half an hour, this ruling of the Executive Committee not applying, however, to the discussion of legislation or resolutions.

PHOENIX AND ITS ENVIRONMENT.

The City of Phoenix, chosen for the location of the Fifth Congress, is in every way well adapted. It is a thrifty and progressive city of 12,000 inhabitants, the capital of the Territory of Arizona, and is excellently well prepared for the reception of even the thousands who will come to attend the Congress. Its local committee of arrangements and reception is already at work, and the promise is extended that every visitor will be furnished with the best of accommodations at prices even lower than usually charged locally. Ample opportunity will be afforded delegates to inspect all points of interest without cost.

Railroad rates will not exceed a single fare for the round trip from all points between Chicago and the Pacific ocean; details of transportation and ticket limitations to be later announced by the interested railroads. Passengers may be routed into Phoenix over either the Santa Fe or Southern Pacific railway systems. Opportunity at low cost will be given for side trips to the Grand Cañon of the Colorado, to the City of Mexico, to Southern California and other points.

E. R. MOSES,

Chairman National Executive Committee, GREAT BEND, KANSAS.

THE ART OF IRRIGATION.

CHAPTER XV. IRRIGATING ONLY A PART OF THE GROUND.

THE PROPER USE OF BASINS.

BY T. S. VAN DYKE.

WHERE the supply is sufficient the whole ground should generally be wet at each application of the water. Especially is this the case in the arid countries, and the shorter the rainfall the greater the necessity for all valuable crops. But in sections generally having enough rain in the growing season, and only occasionally short or not coming at just the right time, such full irrigation is not always necessary and in many cases would be needlessly expensive. The same is the case with many regions where the ground is thoroughly soaked with rain in winter and the subsoil is porous yet so retentive of moisture that it holds almost enough to carry vegetation through and it only needs a little helping out. The former is the case in most of the country east of the Rocky Mountain slopes and the latter on the greater part of the Pacific slope.

In such cases the principal suffering of plants is for water to transpire or evaporate through the leaves, most of the ground being still moist enough to allow the roots to feed. But laboring vegetation must evaporate water from its lungs and skin the same as a laboring man or it cannot do full work, and a crop of high grade produce like fruit may be sadly shortened by the failure to supply water at the right time. But to supply it, it may not be necessary to wet the whole ground.

LIMITED WATER SUPPLY.

Limited irrigation is often required by the nature of the water supply. Perhaps you can get it only in a small stream flowing continuously or nearly so and you find a reservoir to store it long enough to give a good irrigating head more costly than your work will justify. This will often be the case where you are dependent on a small spring or a windmill, horse-power or other means of lifting water from a

well that is fed only by slow seepage and becomes quickly exhausted under a heavy and continuous draft, as is the case with most farm wells. And even under a ditch there may be so many critical times when you cannot get head enough, or for a long enough time, that you may be compelled to water only a portion of the ground.

The objections to this method have been sufficiently detailed in the history of the errors of early irrigators in Chapter IV. of this work. But it is objectionable only when one can just as well do something better. Where it is the best that can be done it generally surpasses no irrigation so far that it is highly respectable. It is available only in those places where considerable can be grown without any irrigation. On pure desert it will rarely do and can never be relied on for anything of much value where the ground, including subsoil, does not in some way get a thorough soaking at least once a year. Otherwise the dry ground around the limited basins or furrows saps the moisture from the watered portion so fast that unless irrigated every few days the ground around the roots cannot be kept in the proper state of moisture. And at any time a little forgetfulness or lack of care is liable to do damage that cannot be repaired that season. As a rule it should not be used for trees or vines carrying crops of value unless they will live in that place by cultivation alone without any irrigation. If demanded for the life of the tree, basins are generally too unsafe a way of supplying water.

GOOD JUDGMENT NEEDED.

The first thing to be done by one who finds he cannot irrigate the whole ground is to learn what kinds of vegetation require the most water and what the least, with the intermediate classes, and also

what will suffer the greatest loss if it fails to get water at the proper time.

The difference between the orange and the lemon is a good study, for it represents a difference that exists more or less between all kinds of vegetation.

Either tree worked to full capacity for the largest and most uniform yield of first-class fruit demands more water than any other tree grown for profit in the United States. Yet either will live for months and even years in ground and air dry enough to kill almost any of the forest trees of the Atlantic States in a few weeks. I see daily (in Los Angeles, Cal.), and can see out of my window now as I write, lemon and orange trees living and bearing this 28th day of December that since the last rain, in April last, have not had a drop of water from any source, stand in hard, uncultivated ground and are utterly neglected. And the entire rainfall of the preceding winter was but sixteen inches, and that of the winter before but nine.

QUALITY AND QUANTITY.

So far both are alike. But now comes a very important distinction. With the orange in California neglect of any kind shows itself immediately in the *quality* of the fruit. You may have a tree well loaded without an orange on it fit to eat. And when you come to market the crop you may find it a dead loss. For the oranges on the trees above mentioned you could not get a cent a box from any one. But the lemon will generally show neglect only in the *amount* of the crop and the size of the tree. The flavor of the lemons on a neglected tree will differ little if any from those on a tree well cared for. And if properly cured they will be about as juicy for their size. They will be smaller than on a well tended tree, but then size in a lemon is not as material as it is in case of the orange. In fact the market does not want lemons too large. Consequently you may have crops of lemons that are very profitable from trees that would bankrupt you if they were oranges, a difference very plainly seen in many parts of Southern California.

The same difference is seen in many other things, and though it may be less in degree is none the less worthy of consideration in deciding what you will plant under a water system that is not quite as

perfect as it should be. The English walnut will live in almost as dry ground as the almond, but the meat of the nuts will be shriveled, and one side often lacking entirely, while the almonds will be as solid as ever and merely reduced in size to a point little affecting the market value. The oil olive, the only olive eaten in Europe, is not perceptibly affected in quality by suffering from water and the difference is only in the yield, while the big, insipid olive grown to sell to green-horns who buy for size and color and eat it for style will be a failure for lack of attractive size. The flavor of a peach is much more easily damaged by shortage of water than that of an apricot, while the latter ripens so much earlier than most varieties of the peach that there is little danger of being caught in a spell of the very hot weather that makes fruit suffer very quickly if not given enough drink. Runty grapes are generally fair in flavor and are generally more valuable for wine than if made big with water, but runty cherries will make even a well-bred hog mad. Scrubby apples will make good cider and do to bake or cook, but scrubby plums are an abomination, and abortive nectarines are unutterably vile.

VEGETABLES.

There are similar differences in vegetables. You may be very stingy of water to your tomatoes before they seem to suffer and when they do they will only be smaller, more watery and not so good to eat raw. But the flavor will be little impaired, if at all, and for cooking you may see the difference. But you cannot stint celery in the least if you want to sell it, and unless it has plenty of water you will want little of it yourself. Nubbins of sweet corn still taste pretty well and potatoes may be reduced considerably by drouth and still be mealy. But don't try the same experiment with egg-plant or cucumbers. Pumpkins and squashes will generally show the difference in amount of water only in size, but if melons lack the right quantity they will be flat and often sour. These differences are too extensive for further discussion here, but those given will serve as guides for farther study. You can soon learn what things in your locality and on your soil suffer the least under bad treatment and if you are compelled to limit your irrigation in any

way plant those things and leave the raising of more delicate stuff to those more fortunate in water supply.

LIMITED IRRIGATION METHODS.

Irrigation of this limited form is very simple. The commonest form is limited flooding by means of basins. Some make them square, some oblong, some round, the shape often varying to the slope of ground. The size varies according to the age of the tree or vine and the water supply and the way of delivering it. In some places the area thus wet is nearly one-half the whole ground, in others not a tenth. Where you have a head of several inches of water you may make them large, but if you try to fill large basins with a small head you will wish you had sublet the job. It will be still worse if you are using a water cart or barrel on a sled, a method you had better always avoid, though there are times and places where it will pay very well to help out something. I have many a time seen an orchard in the east where the crop was a total failure but could have been made quite profitable by a few days' work with the sled and barrel at the right time. But instead of relying on such things you will do better to go where you don't need them.

It is best to feed these basins from a furrow running along the upper side and so arranged that when one is full the water will pass to the next. Otherwise you may injure your ribs leaning on your hoe too much. Grading of the ground is not so essential with this method as with the others, and basins are often used because ground is too rough grade for the other methods, yet not valuable enough to terrace. But it is quite important to have the water flow at uniform rate on every line it is to flow on at all, and if not convenient to arrange the ground to have it so, then plant the trees on such lines of regular flowage as may be natural. Otherwise you will be troubled with the water cutting out and running down hill, and if you don't have it so it will flow on to the next when one basin is filled and it may break the lower side of the basin and cause you more trouble.

As in other flooding, the water should not stand too deep or too long in basins. It is better to repeat oftener than to try to force in so much at a time as to make a mud-puddle of it. Use care, too, to keep

the bottom of it as near level as possible so that the water shall be of nearly uniform depth over the whole. And leave a mound of earth about the tree so that the water shall not touch the trunk. Even if you are not irrigating enough to hurt it, there is no excuse for it and it is bad in principle.

Your water supply may be so limited either in quantity or mode of delivery that you cannot even afford to flood in this limited way. Suppose you have a stream of only a single inch or half an inch, but can have it all the time or most of the time. I am in much this situation myself. Living just over the city line, I am dependent on a neighbor's windmill with several others. The pipes are so small that if I run much over quarter of an inch at a time I take the head off the pipes so that my neighbors can get no water. I have some trees that bear very fine fruit, and like to play with them. I have therefore to utilize every drop of the water, and can spare none for mud to bake in the bottom of a basin. I therefore make a ring about six inches deep about a foot and a half from the trunk of a tree. Two or three feet from this, according to the size of the tree, the amount of fruit on it and what I want it to do, I make another ring surrounding the first. The two are then connected with two or three cross cuts. Into this I run a connection from the next tree by a small furrow; I then start with about one-third of an inch of water, just enough to run over the first furrows and rings and get into those of the next tree without puddling the ground in the first ones. When it has passed on to the last tree I then turn it down to a point that I think my neighbors will stand, and let it run several hours or as long as the tank will stand that time. After the water is turned off, if I happen to be too lazy to cultivate—I don't say that I am—I can hoe back the loose dry earth into the furrows and make a fair mulch of it.

In this way I get the largest results from the smallest amount of water, as it runs clear and makes no mud and does not break away. If I had a good windmill and tank of my own I could manage an orchard of five acres in anything but oranges, which need better treatment for good yields, and raise large crops of good marketable fruit. But this is on ground and under a rainfall that will in most all

years raise fair crops of all deciduous fruits without any irrigation and with good cultivation alone will produce fifty bushels of corn to the acre in eight years out of ten without a drop of rain touching the ground after the seed is planted. On pure desert such irrigation would be about useless, unless almost continuous.

CULTIVATION NECESSARY.

For all this limited work good cultivation is about as essential as for any other. The whole ground should be well stirred to retain the moisture from the rains, and basins should be broken up after each irrigation. Some fill them with a mulch of sand, manure, sawdust, tan bark or other stuff, and never break them. Where they are very small, as around flowers or similar things, this will do well enough,

and also around trees if you do not hire help and have not the time to do it yourself. But it will pay to spade them up with a potato fork each time. And the cultivation of the whole field should not be neglected unless for very good reasons. If the surrounding ground is left dry and hard, it will quickly sap the moisture from the outer edge of the portion that has been wet by the basins, and all the evils of this system heretofore explained will show themselves in their worst forms. And try always to use about the same amount of water for the same length of time. Otherwise uneven wetting of the flower-pot you thus form for the roots will result, and those that are in wet enough ground this time may be the next time in ground too dry.

SOME RECENT DECISIONS RELATING TO IRRIGATION.

BY CLESSON S. KINNEY, OF THE SALT LAKE CITY BAR.

IN all the states of the arid region there should be a statute authorizing the condemnation of lands for rights of way and reservoir sites. And for the purpose of working the greatest good to the greatest number this law should be broad enough to permit the condemnation of water rights. Of course, just compensation must be given in each case. Coupled with this law there should be another. A law should be enacted compelling the various persons or corporations operating irrigation plants to deliver water (should they have it) to all persons applying therefor in their order, provided a tender of just compensation or the legal rate for such water be made. Some states have these laws, but many have not.

In the recent case of the Northern Colorado Irrigation Company, plaintiff in error, vs. Richards, decided in the Supreme Court of Colorado, and reported in 45 Pac. Rep., 423, upon the above subject, it was held: In an action against an irrigation company for refusal to furnish plaintiff water for irrigating land lying under defendant's canal, and having no other source of supply, plaintiff testified that he applied to defendant's manager to learn the water

rates, and told him that he was willing to pay \$1.50 per acre, and that the manager showed and read to him the contract, and said he could not furnish him the water at that rate unless he paid a certain bonus. The court held that the evidence showed a sufficient demand by plaintiff and an unwarranted refusal by defendant.

The general statute of Colorado provides as follows: "Any person or persons, acting jointly or severally, who shall have purchased and used water for irrigation for lands occupied by him, her or them, from any ditch or reservoir, and shall not have ceased to do so for the purpose or with intent to procure water from some other source of supply, shall have a right to continue to purchase water to the same amount for his, her or their lands, on paying or tendering the price thereof fixed by the county commissioners," etc. The plaintiff applied for and procured water for the irrigation of 120 acres of his land during the season of 1888, paying therefor the rate fixed by the county commissioners; broke and improved the land and used the water on it for that season. This gave him a status which enabled him to invoke the foregoing provisions of the statute, in

so far, at least, as to require the company to accord to him a preference to the same amount of water, for subsequent years, over new applicants. And the court upon this subject so held.

And upon the subject of damages where in an action against an irrigation company for the refusal of the company to furnish water in the year 1889, to irrigate his land lying under the company's canal, and having no other source of supply, it appeared that the plaintiff obtained water from defendant in 1888, and in the spring of 1889 demanded water for that season. There was evidence of the rental value of the land for 1889, and that plaintiff had, in preparing to cultivate his land in 1889, purchased horses, farming implements, etc., and made other expenditures in the way of permanent improvements, and of the amounts he paid for each; that prior to the demand he had plowed and planted forty acres; that he raised a partial crop; that, had defendant furnished water, he would have realized from the increase in the yield about \$1,500, without deducting

the cost of raising, harvesting and marketing; and that he lost \$800 in fruit and native trees. The rental value was not limited to the 120 acres, for which defendant was obligated to furnish water. The court held that the measure of damages was the difference between the amount realized from the crops and the amount that would have been realized had the water been furnished, less the cost of raising, harvesting and marketing, together with the loss of the trees and the loss of use of part of the 120 acres plaintiff was prevented from cultivating; that for lands not seeded at the time he was entitled to the rental value; that, if by reason of defendant's refusal, the improvements and preparation became in part useless to plaintiff, or were of less value and use to him, the fact of such improvements, etc., should be considered in estimating the damages, and that he should be allowed the rental value of his land in its improved condition, if he was deprived of the use thereof by defendant's wrongful conduct.

WINDMILL IRRIGATION.

NEARLY every farmer can find a few acres on his farm with a water supply, either from well or creek, and a surface suitable for irrigation. On sandy plains, which are usually level, large tracts of land are fitted for this system of farming, being leveled down or filled up in order to make the entire field, or set of fields, present a proper surface for flooding. Windmills, as now constructed for irrigation purposes, can successfully compete with irrigation canals, and they are more satisfactory, as the first cost is the only one. Each man owns his own plant, and is not subject to constant outlay of money to go into the hands of the owners of large irrigation systems.

In those regions called semi-arid, where only an occasional watering is needed, other than that given by nature, farmers in general do not attempt to irrigate their entire holdings, but only a small acreage of garden, root crops, fruit trees, and occasionally a grass plot. Such places being isolated from any general irrigation system, much economy must be looked for in the use of water which usually must be pumped up from small streams or wells of varying depths. Whether the water be obtained from either of these sources the farmer can choose for himself, taking that system which will be cheapest and most suitable to his location and surroundings.

INCREASE IN VALUE OF LAND.

Thousands of acres of land which in the past have been worth from 50c to \$3 per acre and have been considered practically valueless for cultivation are suddenly increased in value to \$25 or \$30 per acre by the use of a windmill irrigation plant. The soil in the semi-arid regions is the most fertile in the world and it simply requires water to make it produce abundant crops of every nature.

THE RESERVOIR.

Too much importance cannot be given to the necessity of sending over the ground a large volume of water at one time. It must be a flooding of the ground, not a moistening. In some cases the greater the depth of water that is put on the ground at one time the better; hence the

necessity of an ample reservoir. In no case should one be less than 50 feet in diameter with walls that will hold water four or five feet deep, and a larger reservoir is preferable.

Where a small reservoir is used a correspondingly small piece of ground must be flooded each time and the flooding must be done oftener. This has its advantages in this, that there is not so much water lost by evaporation from the reservoir while filling. The best form of reservoir is round. A round reservoir exposes less wall through which the water can seep, and from which it can dry out, and is easier to build.

In a round reservoir 50 feet in diameter and four feet deep there is 18 per cent. less wall surface than in a reservoir of equal capacity built up square, and if the reservoir were built long and narrow the amount of wall surface in proportion to its holding capacity would be vastly increased. However, in the opinion of some, reservoirs should be built oblong, say 50 feet wide and 100 feet long, or 100 feet wide and 200 feet long, etc., and extending at right angles to the prevailing wind, as the momentum of the waves in traveling a considerable distance will be likely to injure the banks. A location should be secured if possible, with hard pan or tough clay subsoil. If possible place it on the highest part of the plot to be irrigated and as near as possible to the source of the water. If there is any slope whatever let it be away from the reservoir. It should be borne in mind that hillside as well as level ground can be profitably irrigated, if proper care is taken in the location of the reservoir. Occasionally good results are obtained by building a dam across some depression thus necessitating an artificial bank only on two sides of the reservoir. Sometimes also a sloping depression on a hillside is inclosed at the lowest part by a substantial dam. Most reservoirs are made by simply scraping up from the outside of the reservoir a ridge of dirt sufficiently high to give, 4, 5 or 6 feet of water on the inside. No dirt should be thrown up from the

inside of the reservoir because it is desirable to keep the bottom of the reservoir as high as the surrounding land, and and because the surface of the ground holds water much better than the strata further down. However if there is any sod upon the ground where the embankments are to be made, the ground under the locality of the embankment should be thoroughly ploughed, and the sods removed as sod is not a proper material for the construction of embankments, and there would always remain a possibility of water seeping through at the bottom of the embankment.

the embankments are constructed it is well to fill the tank partly full with water and allow it to seep out.

While the bottom is still muddy turn into the reservoir horses and cattle, and drive them around for many hours, thoroughly puddling and pulverizing the ground. Some invert a scraper, and with two teams of horses drive around upon the inside of the inclosure, riding in the scraper. If this work is done thoroughly you will have a reservoir which is practically water tight. In sandy soil it is well to haul in old straw and hay, scatter it around, and tramp it into the mud as

This is a reproduction from a photograph of an irrigating outfit owned by G. M. Davidson, Larned, Kan. It consists of a 12 foot pumping Aermotor on a 30 foot steel tower with an 8 inch irrigation pump. The mill is never turned off and irrigates perfectly 10 acres of ground, which is kept thoroughly soaked. The reservoir is 60 feet in diameter, 5½ feet high and the pump fills it in 10 hours.

Now, with an ordinary scraper commences scraping up soil from the outside of the reservoir to form the embankment. The earth should be thoroughly leveled, pounded and packed, as it is thrown in place. No attempt should be made to mix rock or other material with the dirt composing the walls. The embankment should be very wide at the bottom, sloping up very gradually from the inside, as the waves would destroy perpendicular embankments. Walls from four to six feet in height are usually to be preferred. When

much as possible. If the bottom should still continue to seep, it will be necessary to haul in a few loads of earth or clay. Every western farmer knows of the dry buffalo lakes that are found everywhere upon the great plains. Material taken from these lakes is most excellent for the construction of the bottom of reservoirs. Additional hay or straw can be put in, and it will in time make the bottom of the reservoir practically tight.

There exists no necessity, except in some extreme cases, for the use of cement, pitch

or tar, as the reservoirs, by hauling in a sufficient quantity of mud, clay or even the magnesia deposits that are found all over the west can be made practically impervious to water. The dirt walls upon the inside are much better if sodded; otherwise they are likely to cause trouble by the washing of waves. An excellent plan will be to riprap the embankment on the inside if stone can be had. By rip-rapping we mean to place stone closely together without order on the inside of the embankment. It is often the case that planks are thrown into the reservoir, which will of course be blown to the opposite side from which the wind is blowing, which will prevent in a measure the waves from washing against the bank. An excellent plan is to plant water willows all around the embankment, which will in a short time grow up and serve as a very effectual wind break.

In the construction of reservoirs where the depth of wells is such that more power and expense is required to lift the water, great care should be exercised in their construction. It is well in such cases to make a deep reservoir. These should be constructed more slowly than where the mills are pumping from shallow depths.

Build up the sides of the reservoir about two feet in height, then turn in the horses and cattle, and allow the puddling operation to go on for a couple of weeks; then raise the banks another foot and continue the process as before. In this way reservoirs can be made upon the upland where the depth of water within the reservoir can be maintained at a depth of seven or eight feet. This will insure less evaporation, and therefore greater economy.

Photographic reproduction of a windmill irrigating plant owned by T. J. Dyke, Garden City, Kan. It consists of two 12 foot Aeromotors with 10 inch pumps upon 12 inch strokes. The reservoir is 100x150 feet and 4 feet deep. The water is raised 15 feet. The amount of land irrigated is 23 acres.



THE DIVERSIFIED FARM

In diversified farming by irrigation lies the salvation of agriculture

The Age wants to brighten the pages of its Diversified Farm department and with this purpose in view it requests its readers everywhere to send in photographs and pictures of fields, orchards and farm homes; prize-taking horses, cattle, sheep or hogs. Also sketches or plans for convenient and commodious barns, hen houses, corncribs, etc. Sketches of labor-saving devices, such as ditch cleaners and watering troughs. A good illustration of a windmill irrigation plant is always interesting. Will you help us improve the appearance of The Age?

THE AMOUNT OF WATER NEEDED FOR EACH IRRIGATION.

BY F. C. BARKER, OF NEW MEXICO.

THE amount of water needed for irrigation in the arid regions is a very difficult problem to solve. So much depends upon varying circumstances, such as the kind of crops, quality of soil and the amount of evaporation. As a rule, I think, writers upon this subject err in fixing the quantity of water too low. Indeed, there seems to be a kind of rivalry as to who shall lower the record. I will, however, give a practical instance of how much water actually may be needed, as it will be of considerable service to gardeners and others who contemplate erecting windmill pumps.

In June last I erected an eight-foot windmill and pump, lifting water about twenty-one feet into a reservoir holding 55,000 gallons of water. Theoretically the pump would lift 800 gallons per hour, with a fifteen mile breeze, which would fill the reservoir in seventy hours, or say three days. But fifteen-mile breezes cannot be relied upon to blow continuously every day, and as a matter of fact it usually takes twelve to sixteen days to fill the reservoir. Presuming that it was filled and emptied twenty-four times in the year, there would be enough water to cover two acres of land with twenty-four inches of water in the course of the year. Now, most writers on irrigation maintain that this amount of water is sufficient for anything, and indeed that, with proper cultivation, even twelve inches are sufficient. But an ounce of practice is worth a pound of theory, and this is what I actually found in practice to be the amount of water needed.

I had put in an acre of strawberries, and the windmill and pump were erected so as to give water in case the river, from which

we usually irrigate, went dry late in the summer, which it is very apt to do. We got our last irrigation from the river on July 2, and on July 15, as my reservoir was full, I decided to irrigate from that, although the strawberries had not yet begun to suffer from drouth, and the soil at the depth of five or six inches was quite moist. The water in the reservoir was about four feet six inches deep, and the outlet (6x4) emptied it in a little over two hours, so that we had a good head of water, indeed as much as the laterals would carry. The actual amount of land irrigated was just four-sevenths of an acre, so that the soil had taken up three and a half inches of water. There had been very little loss by seepage in the laterals, as these had been previously puddled by muddy water of the river, and as I have said before, the land was by no means exceptionally dry. The beds were irrigated by the flooding system, but had I opened up small furrows by means of a hand wheel plow, I daresay I could have easily irrigated three-quarters of an acre, using, say three inches of water.

These results go to show that crops like strawberries, needing an irrigation during the dry season every ten or fifteen days, will require from six to nine inches of water in the month, which is a totally different theory to twenty-four inches in the year. One ought to reckon by the month and not by the year, for there are many months in the year in which little or no water will be required. Compared with many of the results of windmill irrigation, which are given in the papers and printed as testimonials, the above looks very much like a failure. So far as I am concerned, it was a success, for it saved my strawberries, which at a very low estimate are worth \$300, which was just the cost of the windmill, pump and reservoir, so that the in-

vestment has paid for itself the first year.

I ought to mention that I have a driven well, with a four-and-a-half inch Cook's strainer for a point, and as it gets into quicksand or coarse gravel the water flows in very freely. Indeed, I believe it is nearly if not quite equal to an open well, for the pump lifts about the same amount of water that the manufacturers claim it should lift in an open well, which would be too costly here, owing to the quicksands.

So far as I am able to form an opinion, I am inclined to think that where more than small gardens of one or two acres are to be irrigated, a gasoline engine would, on the whole, prove more satisfactory than a windmill. It is true that the running expenses would be greater, but the initial cost would be less. Moreover, after the first forty-eight hours run, one is able to form a pretty accurate estimate of the amount of land that it will be safe to put under crops, whereas, with a windmill, one has a very uncertain element to contend with, necessitating a much larger reservoir so as to provide against calm weather.

CALIFORNIA'S ORCHARDS.

BY W. C. FITZSIMMONS.

FROM the different county assessors returns the following figures of orchard trees in California are taken and may be regarded as wholly reliable. In two counties, Yolo and Sierra, the number of non-bearing trees does not appear in the assessors' report, but leaving those out the number of bearing fruit trees in the state is found to be 15,170,563, and those not yet of bearing age, 14,487,869; making a grand total of 29,658,432 fruit trees in the orchards of California on the first day of March of the present year. By adding to the list of non-bearing trees the probable number in Sierra and Yolo, the total list of trees would be swelled to a round thirty million at least, and that figure may be taken as the official enumeration of the fruit trees now growing in the orchards of this state. The banner county is Santa Clara, whose principal town is San Jose, sixty miles from San Francisco. This county has 2,631,745 bearing fruit trees and 1,933,804 not yet bearing. Of these 1,651,167 are bearing prune trees and 1,456,967 non-bearing prune trees. This regal county also has 539,612 apricot trees

and 522,776 peach trees. The cherry trees number 159,263, the pear trees 142,779 and the lemon trees 1,354.

Los Angeles county stands second on the list with 734,675 bearing; and 1,911,030 non-bearing fruit trees. The principal factors in this vast aggregate are as follows: orange trees, 751,575; lemon, 287,715; prune, 346,595; olive, 252,940; apricot, 227,410; almond, 172,850; walnut, 140,875; peach, 315,400; apple, 77,380.

Riverside county ranks third in the number of its fruit trees, the total being 1,855,902, of which 841,132 are orange, and 133,772 lemon trees. The apple, apricot, peach, cherry, fig, olive, prune, plum, almond and walnut are also well represented in Riverside county, the planting of these varieties having increased greatly during the past three years.

San Bernardino county follows close to Riverside with 1,753,720 fruit trees, of which 1,001,410 are orange and 41,000 lemon trees.

San Diego county has most lemon trees, that being a favorite product of the southernmost county in the state. The total number of fruit trees in that county is 1,235,076 of which 375,372 are lemon trees.

One of the remarkable features of the assessors reports referred to above, is the fact that Butte county has 160,430 orange and 1,930 lemon trees, all growing and most of them bearing fruit within a few miles of the eternal snows of the Sierra Nevada mountains, and five hundred miles north of the smiling citrus orchards of sunny San Diego. In fact the unpoetical figures of the county assessors but serve to strengthen the conviction that the state of California, with its infinite variety of soil, climate and conditions, is soon destined to be recognized as the world's great fruit orchard.

Marketing.—Common sense and good judgment must be brought into full play in marketing your products, of whatever kind. The profits are all found, if there are any, in the last dollars you receive as the price ranges from low to high.

Leave the irrigating ditch in good order when you shut off the water and it will save you needless worry and trouble when you turn the water in next time.

Beet Sugar.—An idea of the growth of the beet sugar industry can be gathered from the following figures, which shows that the beet sugar made in the United States was in

1891.....	10,281,850 lbs.
1892.....	24,875,876 "
1893.....	50,000,000 "
1894.....	70,000,000 "
1895—Estimated large increase over 1894.	

Japan is only importing 25 per cent. of its requirements now, as against 67 per cent. six years ago. This fairly illustrates how the gold standard is not opening the markets of the world to our manufacturers. It is developing the industries of all silver-using countries and destroying the industries of the United States.

Money of ultimate redemption in a county printing office—gold, silver, copper, brass, fenceposts, hay, grain, live stock, potatoes, woodpiles, sawhorses, fishpoles, bedclothing, old hats, carrots, anything and everything in fact. Bring in a wheelbarrow load.—*Mt. Pleasant (Utah) Pyramid.*

For the past few months the University of Illinois has been furnishing Pasteurized milk and cream to families in Champaign and Urbana. The greatest care is taken in its preparation, and the floor of the dairy barn is flooded and scrubbed every day. The undertaking is meeting with great favor.

The manager for an Australian enterprise for exporting live cattle to England admits they have no chance of competing with North American raised beef. The longer passage required injuriously affects the quality and appearance.

Minnesota creameries turned off 27,000,000 pounds of butter in 1895. The proportion of creameries using the separator process has increased from 45 per cent. to 60 per cent. of the whole, and those operated on the co-operative plan from 42 to 60 per cent.

During May, the exports from the United States were \$66,525,169, as against \$64,267,179 in May, 1895. For eleven months ending May 31st, they were \$815,971,764, against \$752,570,335 for the corresponding months last year.

Four thousand boxes of pears and plums, the first shipped this year, reached

London by the steamer St. Louis on the 23d of July in perfect condition and sold for handsome prices. California fruit is gaining in popular approval.

A visitation of army worms in the eastern states is a new experience, and in several localities the damage has been very great, and in some of the cranberry bogs almost irreparable.

The French prune crop of the Pacific states is exceptionally fine in size and quality this year, and is estimated at 35,000,000 to 40,000,000 pounds.

It is no loss of time to give the boys and the hired man an occasional outing. It affords rest for them and breeds good feeling for you.

Watch closely and be prompt to eradicate every disease that appears, no matter how radical a remedy may be necessary.

A ton of well cured corn fodder has nearly as great a feeding value as a ton of average hay. It should not be wasted.

Time spent at the county fair is about as good an investment as the farmers can make of it for himself and his family.

When cattle reject corn fodder it is because there has been something wrong about the cutting and curing of it.

Many varieties of fruits and vegetables are excellent for home use that are not profitable to send to the market.

Many western packing houses are closed, there being a very limited demand for products, despite the low prices.

Sixteen white chickens and one black one hatched in one brood have been exhibited at Springfield, Mo.

The good wife is just as much entitled to have extra help when there is extra work as is the good husband.

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Some farmers produce at less cost than others. Why? It is worth thinking about.

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VOL. X.

No. 4.

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IMMIGRATION AND THE MAKING OF COLONIES.

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THE IRRIGATION AGE.

VOL. X.

CHICAGO, OCTOBER, 1896.

NO. 4.

THE PROGRESS OF WESTERN AMERICA.

Stagnation of Immigration. More and more, as the stagnant condition of irrigation enterprises in general is recognized, does it become evident that upon colonization depends their salvation. Very few of the men who organized irrigation companies and concocted plans for reclaiming the desert, gave to this most important feature the consideration it merited, or, in fact, gave it the consideration it must have in order to insure the success of their enterprises. The building of dams and ditches and the furnishing of water does not constitute a completed irrigation enterprise. By far the hardest work yet remains to be done. Colonies will not organize and locate themselves, and the systematic study and active operation of the best means to promote immigration is the only door through which will come back the vast sums of money that have already been expended. It is not the writer's purpose to review the failures that have been made, nor to enter into details of those other absolutely essential factors of an irrigation system—water supply and able engineering. But it seems particularly appropriate, at the close of the present season, when so many of the companies have closed their eastern offices, to briefly discuss a few of the more prominent factors that have led to these results. Behind all of these effects stand fundamental causes, and the inflexible laws that govern human affairs must be studied carefully and thoroughly and with a mind fitted to grasp and understand their true meaning, before success can be hoped for. The movement of population from town to country and from country to town is governed by laws as fixed and rigid as those that govern the science of money. Coun-

try people do not seek the cities from mere impulse, and sentiment is not the greatest factor in inducing city people to lead the life of a farmer with its drawbacks and its advantages. Beneath this there is a motive. It is the hope of improved condition, either in mind, body or estate—in health or in prosperity.

Colonial Idea Developing. Upon a correct interpretation of this hope rests the future—not alone the future of irrigation, but the future of the country, because irrigation is the safety valve of America. It is needless to show that we are rapidly approaching a European standard of concentration of people within a circumscribed area, in order to show the nearness to the danger line, because we have already begun to feel some of the effects of this concentration, and a man who has been stung by a bee does not need to be told that a nest of them is more dangerous than one. The question is, "How can the congested population of the cities be taught to seek the country?" The answer must lie in a visible demonstration of the hope for better conditions. Irrigation furnishes the basis for this realization. It presents a method of preventing that which the antagonists of anarchy dread, and it presents an opportunity of accomplishing that which philosophers, philanthropists and statesmen so much desire—the bettering of humanity. And this question must be solved, not alone by those who would directly profit thereby, but by the people themselves. The colonial idea, which has been placed before the public by one of the foremost of America's writers on the subject of irrigation, is getting nearer to the heart of the people, and

it would not be surprising if the next twelve months saw some wonderful developments in this line.

Associative Colonies. The associative principle, as distinct from the co-operative, is making strong friends, and it both leads to and follows as a consequent the forming of colonies. It is an essential ingredient of success. It can be traced to its earliest beginning in the dawn of civilization, when men gathered together for mutual protection and conquest. And it now offers a sensible and practicable method for "The Conquest of Arid America." The association of people with a common purpose in view is the lever that will move population westward to settle on the irrigated farms and in the villages and towns, to create industry and prosper, to foster culture and social aspirations and to establish a civilization that will be a type of all that is highest and noblest. But this will be the work of time. To accomplish it many forces will have to combine. What is needed now is the study of this question and the systematic promotion of immigration by the legitimate irrigation enterprises. Immigration can be secured only by offering superior advantages. Climate, soil, products, markets may all be right, and still there be a lack of activity. It is here that the associative principle comes into play. The average man will not, for himself or his family, willingly choose to live a life of isolation. He must have neighbors; he yearns for human companionship.

The Dawn of a New Day. It is in the "Model Colonies" that have been set forth heretofore in the pages of this magazine that he sees the nearest approach to a realization of these hopes. And the almost unnoticed currents that have been tending in this direction are concentrating into a broad and deep channel and flowing onward with the force of a mighty river. Already is it gathering itself for a plunge. This tide is destined westward where the most inviting conditions are offered, where irrigation presents the greatest opportunity a nation ever had for conquest and the founding of an empire. It is time for the men of the West to arise and with one voice welcome the dawn of this new day which has appeared on the eastern horizon. It will lead them out of the

wilderness of financial difficulties and embarrassments in which they find themselves through a lack of knowledge of natural laws. Then let every effort be made to hasten the day of realization.

A Southern Drought. The drought, it seems, is not confining itself to its usual habitat in the far western states. For the second time in the past two years it has invaded southern territory. This time northern Louisiana is suffering, and already calls for outside aid are being made for the benefit of those whose crops were failures. The South, in a general way, began to take an interest in irrigation a few years ago. Last year a convention was held at Atlanta, which was reviewed in these columns at that time, and the engineering societies and clubs of the southern states began to discuss the subject, but by far the greater proportion of the farming element has taken little interest in this matter up to this time. Irrigation is not a new idea to the South, as it has been in practice there on the rice fields for many years (as shown by Mr. Hutson's contribution in this issue), but the idea that it could be applied to general farming, market gardening and fruit raising is new. Those who had the courage to undertake something which, at first sight, seemed to be out of the beaten path, have profited thereby, and their visible success is convincing the doubters. Irrigation is now, to a limited extent, applied in the raising of small fruits and vegetables in all the southern states bordering upon the Atlantic and the Gulf. Its greatest application, however, is in the rice fields, and as an instance it may be mentioned that in the Lake Charles district, in southwest Louisiana, over 3,500 self-binders are in use at this time harvesting the rice crop.

Fairs and Conventions. Within a short time another season of fairs and conventions will have been added to the list. From north to south, from east to west the citizens generally, and the farmers particularly, have given themselves to the enjoyments of the county fair and its larger expression—the festival of Ceres. In the northwest the Minnesota state fair and festival at Minneapolis, not to mention the annual encampments of the G. A. R. and the Knights of Pythias, attracted wide attention. The fair, while a local institu-

tion, was not confined to the state boundaries. The states of Montana, Idaho, Washington and Oregon were represented by exhibits from their farms, orchards, forests and mines. To the general exhibits were added some special features, and of these the most noteworthy was the exhibit car of the Northern Pacific Railway. It was a splendid demonstration of the resources of the northwest, and was constantly filled with crowds of people. In the southwest the fair at St. Louis easily occupied the place of prominence, while it must not be forgotten that Omaha and Kansas City were close behind. As for the festival of Mountain and Plain at Denver, it was unique in the extreme, and excited the wonder of eastern visitors. The details of each of these festivals, and the innumerable others that have been or are being held, is already well known, and it is not our purpose to enter into them further, except to show their influence upon irrigation.

Their Relation to Irrigation.

It is cause for congratulation among those who are working in behalf of irrigation, that it has begun to occupy, in a measure, the position that it merits as the most scientific and sensible method of practical agriculture. With scarcely an exception it was represented at each of the exhibitions held west of Chicago, and at many of them it occupied its rightful place of prominence. It cannot be denied that while irrigation is of more direct importance, and capable of being more successfully applied, in our western states, where the lack of rainfall makes it necessary, and because this lack of rainfall makes it possible to apply water when vegetation needs it and prevents floods, which destroy crops as quickly and easily as drought, there are numbers of inhabitants of the prairies and valleys who have hitherto failed to see that they could not carry on their farming operations as did their fathers and grandfathers. And notwithstanding the loss of crop after crop, and with failure staring them in the face, they have concluded to trust once more to the element of chance—that it might rain when their crop needed it. It is among these “farmers of the old school” that the agitator of irrigation has been and must continue to work. But it is a pleasure to chronicle the fact that these farmers are now turning to irrigation with

enthusiasm, that they appreciate its advantages and realize that they are no longer dependent upon chance for success.

The North Platte Fair.

At the time of writing this there is being held in North Platte, Neb., an irrigation convention that is remarkable in several ways, but more particularly in demonstrating the progress that Nebraska, and not only Nebraska but the entire semi-arid region, has made in solving the question of agriculture on the great plains. No longer does Nebraska ask aid for its drought sufferers; no longer is the population decreasing because of unsuccessful farmers leaving the state for more favored regions; they are irrigating with the aid of canals and ditches and with windmills and pumps, and they have again begun to feel that spirit of conquest that filled them when they undertook to make homes for themselves and families on the lonesome prairies. But the practical side of irrigation predominates at North Platte. It is the side that most quickly appeals to the average farmer; “How can we irrigate?” And the officers of the irrigation fair have attempted to answer this query. They have arranged an exhibit of windmills and pumps; they have built a miniature canal with laterals; they have every variety of appliance needed in irrigation, and above all else they have made an exhibit of the products of irrigated farms and orchards, a practical demonstration of what has been done.

Good Roads.

Never before in a political campaign has there been manifested such an interest in “good roads” as is shown at the present time. The bicycle associations all over the country have taken up the battle for good roads, and are requiring pledges from their local candidates favoring the use of convict labor upon the roads, instead of using the inmates of penitentiaries as heretofore in producing manufactured articles in competition with free labor. No one, except the companies and individuals who benefit thereby, will contend that the contract system in vogue in many of the states is a wise method of employing those who have been convicted of felony, and it has long been seen that a change must be made. The building of good highways would benefit not only the

AN IRRIGATION FLUME LINE IN SOUTHERN CALIFORNIA.

particular localities through which they pass, but it would benefit the state at large, and no one would derive more benefit from this improvement than the farmer. As an instance, it is estimated that in the state of California alone the cost of transporting products over roads, good, bad and indifferent, was \$66,000,000 last year, whereas, if the roads had all been in good condition, it would have cost only \$36,000,000. This saving would have been placed to the credit of the farmers. While it is true that there has, in the past, been a feeling of antagonism between the farmers and the wheelmen, it is now time that both sides should be willing to make concessions, in order that both may benefit. The movement in favor of good roads deserves general and hearty support.

Secretary Coburn, of Kansas. The object lesson that Secretary Coburn of the Kansas State Board of Agriculture offers as a means of making his official position and labor therein of practical value to the farmers, is indeed a striking one. This indefatigable secretary, with an amount of labor that is simply wonderful, prepares bulletins and reports and scatters them far and wide, and not the least feature of this is that every bulletin and every report is of the most intense and practical interest to those for whom they are intended—the average farmer. The work done by the state boards and schools of agriculture and the governmental experiment stations cannot be overestimated. No other single industry is so well cared for as agriculture, and no other industry so much needs it or so well repays the time and money spent by the state and federal governments.

Steady Progress. In no department of journalism has there been a greater advance, both as to the number of its representatives and the character of its contents, than in the agricultural and horticultural press. Within the past thirty years even those which were thought in the earlier days to be the best possible, have introduced improvements of great importance, and have kept well abreast the times in every respect. They have been, and are a vast power for good. They disseminate information which affects the material and social welfare of the largest single class of our population, and are now commanding and liberally compensating a high order of talent.

Significant Protest. The Northwestern Wholesale Grocers' Association addressed a formal communication to the leading dried fruit association of California, of which the following paragraph was a part.

"This Association, representing as it does all the wholesale grocers doing business in the Northwest, protests against the present demoralized condition of the dried-fruit market, growing out of the indiscriminate shipments of dried fruits by the fruit-growers of your State to farm produce and green-fruit dealers in this section of the country.

Important Decision. The United States Supreme Court some time ago decided that the desert land law did not apply to lands within the limits of a railroad grant. It naturally follows, although this particular point has not been officially determined, that all entries under the desert land act were erroneously allowed, and that where the final proof and payment was not made, the entrymen were entitled to the amount they had paid, under the act of June 16, 1880.

IRRIGATION OF RICE IN SOUTH CAROLINA.

WHERE IRRIGATION HAS BEEN PRACTICED FOR A CENTURY.

BY WILLIAM FERGUSON HUTSON.

WITH the probable exception of some of the lands originally cultivated by the Franciscan missionaries in Texas and New Mexico, the rice industry of South Carolina and Georgia is the oldest example that we have in this country of a system of agriculture based on irrigation, and absolutely dependent on it for its existence. The records as to when the different plantations were cleared and banked are, with scarcely an exception, lost; some in the Revolutionary and the rest in the late war, but the places are nearly all about as they were a hundred or more years ago, for so well were the fields laid out that the modern planter finds little in their arrangement that he need ever change. Many things, including the climate, character of the labor, and system of cultivation under which each planter controls his own water supply, force the use of large plantations and forbid any attempt to plant it by small farmers.

The planting of rice is confined to the "low country" near the coast, almost the entire South Carolina crop being raised in the coast counties of Beaufort, Berkeley, Colleton and Georgetown, where the country is very flat pine land, intersected by many creeks and rivers, which originally spread wide on either side, making great swamps and marshes. These were cleared, diked and drained, and the differences of locality gave rise to the two different methods of irrigation now found in this region. On the reclaimed swamps and marshes along the large rivers use has been made of the tides, which, coming far up the rivers, back up the fresh water and thus raise it above the level of the fields, while in the once swamp lands higher up the water is obtained by putting a dam across some narrow part, thus making a "back water" from which the rice fields below can be flooded. Sometimes these two methods may both be seen in use on the same plantation, a "back water" be-

ing used to flow some fields that the tides cannot reach.

The river places especially are wonderful examples of hydraulic engineering, and everything about them shows that the early colonial settlers of this part of the country must have commanded a large amount of capital to carry out as a private enterprise such a task as the clearing and diking of a large place.

PREPARING THE GROUND.

An idea of the labor that must have been expended in beginning a plantation can be obtained by noticing the general plan of one and the amount of earthworks necessary to control the water. In the first place, all along the river, and wherever the low alluvial fields do not abut on higher ground, it is surrounded by a strong dike about five and a half feet in height, four feet wide at the top, and with the base in proportion. The fields are divided off into squares or plots of various shapes, in accordance with the slope of the land, the difference in level in one square being usually limited to eighteen inches. These squares are separated from each other by "check banks" about two feet high and two to three feet wide at the top. The squares may vary in size in a large field of several hundred acres all the way from ten to seventy-five acres or even more. Through the fields run canals, so placed that each square takes its water directly from the canal by a double floodgate, called a "trunk," into a canal on the other side, though on many river places the water can be let on the land through "trunks" connecting it directly with the river, and the canals are wholly or partially dispensed with. The "trunks" are simply wooden cribs passing through the embankment, covered over with earth, and having a gate at each end that can be raised for the passage of the water. Where the place is flowed by the tide water all of these flood-

gates are automatic; that is, they hang on horizontal pivots, as well as slide up and down, and when the outside gate is lifted to let the water in from the canal, the inside one floats on top of the water as long as the tide is coming in, and flaps back as soon as it begins to ebb, thus holding the water on the field. The same action, with the function of the gates reversed, takes place when it is desired to drain the water off, the outside gate closing when the tide rises.

The canals, which will average four to a field covering a square mile or six hundred and forty acres, are twenty feet in width and five feet in depth, and take their origin, usually, each independently, from the river by similar, though more perfect, automatic floodgates. For the purpose of making the flooding more gradual and even, and to enable the water to be drawn off very completely, each square has a marginal ditch six feet wide and four deep, cut all around the interior edge a few feet away from the embankment, and in addition, "quarter drains," usually two feet wide by three deep, are run in parallel lines across the square at a distance of about seventy-five feet from each other.

CULTIVATION.

The cultivation of the crop involves the use of water at every stage, and is in brief as follows: About the first of January the last year's stubble is burnt off. The land usually has been lying just as it was left after the harvest, but sometimes, where water is plenty, it has been flooded immediately after the crop was taken off, and has remained so until sometime in December. After the burning, the land is ploughed and put into the finest possible mechanical condition. Planting begins about the 1st of March and lasts until the 1st of May, when it has to be stopped on account of the flocks of "May birds" that stop by on their way north, to be known there as the poetical bobolink. In June, planting is begun again, and continued until about the 20th, making a late crop, always spoken of as "June rice." The

rice is sown thickly in drills fifteen inches apart. The water is then turned on for the "sprout flow" and the land flooded as deeply as possible. Then the whole stretch of fields is one vast sheet of water, the only land visible being the narrow intersecting dams. This sprout flow remains on for from six to eight days, after which it is taken off and the field left bare until the rice sprouts sufficiently for a row to be traced as a tiny green line for about a hundred yards. The water is then let on as deeply as possible for the "stretch flow." It remains so for six to eight days again, and is then lowered until the tops of the rice in the lowest parts of the field can just be seen at the top of the water. It is held so for twenty to twenty-five days, just enough water being added from day to day to keep pace with the growth of the rice. This gives the rice, which projects a little above the water, a very rapid growth, while the weeds and grass, being covered, are mostly killed. The fields are then drained and dried off and the rice hoed by hand, following with a horse-hoe. It usually needs a second hand-hoeing somewhat later in this period of dry growth, which lasts forty to fifty days. Then, about the 20th of June, with the earliest rice, the "harvest flow" is put on, and kept on pretty steadily until the rice is ready to cut, which will be, with rice planted on the 1st of March, about the 25th of August. The water in this flow reaches about two-thirds up the stalk of the rice, and is drained off every eight or ten days and fresh water put on. The water now serves a double purpose, for besides promoting the growth of the plant and the consequent heavy fruiting, it supports the stalk, which, heavy with its head of grain, might otherwise be beaten by a single heavy wind down into a ruinous mess in the mud of the fields.

Here ends the function of water in the making of the crop, the main anxiety of the planter being lest such a storm may come up in the two or three days after the water is taken off and before the ground is dry enough for the harvesters to work.



THE ART OF IRRIGATION.

CHAPTER XVI. THE PROPER TIME TO APPLY WATER. CULTIVATION.

BY T. S. VAN DYKE.

“WHEN it needs it” is the answer the beginner is very apt to get when he asks the experienced irrigator what is the proper time to water something.

The question cannot be easily answered even as to any one thing, and anything like an attempt at a set of rules for a general list of products to apply to all places would be very absurd. It is true that you can soon learn to tell by the appearance of anything whether it needs water. Vegetation of every kind has a mute language that one can learn to read as well as print. Long before there is any sign of suffering or wilting in the leaves, an air of weariness steals over the whole, the brightness weakens just a trifle, and if it is a tree well laden with fruit it will not leave you many days, or in hot weather many hours, in doubt about its meaning.

But it is equally true that there is danger in waiting to be thus informed. If you have your own water system and have it well under control, so that you know just what it will do, you may wait if you choose, though, in such case, there is no excuse for taking chances if your crop is very valuable or easily shrunk by a little neglect at the proper time.

Considerable repetition is unavoidable in a work of this kind, and I will here repeat what is one of the fundamental principles of the whole art of irrigation. Repeat it until it is engraved on the bottom of your memory.

There is very little difficulty about getting fine fruit from young trees, but when they are old and in full bearing and heavily laden, to bring to maturity a large percentage of first grade fruit requires unremitting diligence. Almost all the profit is in the first grade, and this grade is quickly reduced by the slightest neglect, neglect that will not otherwise affect the tree, would not show on a young tree, and to the common eye may not show on the

old one except in the market returns from your crop. Hundreds of dollars a day may be lost without your seeing it until too late.

This principle applies with more or less force to almost everything in the line of orchard or garden produce that you will raise to sell, and you will never lose by applying it to all field crops as well. It is largely ignorance of this that makes so many different opinions about irrigation and water supplies, and makes so many think they are doing wonders when they are really losing money.

If you are depending on a ditch with others you will probably have to take your turn, and cannot have the water just when you want it. If, then, you are depending on the appearance of anything, the time you may lose in getting the water running may be a loss of many dollars an hour; and yet you may never know it. Far better to do such things on principle.

By the time you have watched things long enough to know far enough in advance of actual suffering that they need water, you will also have learned to calculate in advance the time when things will need it. You will have some idea of how much they need, when they last had it, how long a certain run of water lasts with proper cultivation on stuff of a certain age. You will also note the weather, the heat and the amount of moisture in the air. If wise, you will assist your observations by frequent inspection of the soil six or eight inches below the surface. The soil should never be so dry that it will not easily pack into a ball in the hand. A valuable crop under irrigation should be studied every day, just as a successful merchant spends much of his spare time in looking over the books, no matter how much he trusts the employes. You will thus understand the business so thoroughly that you will always have the water ordered in time and ready to run. And with a growing crop

there is rarely danger of being a few days too soon with the water. It is always the other way.

But if you must trust your eye to tell when to water anything, learn to tell in advance of any suffering. Allow nothing to wilt or twist or look yellow, if you can avoid it, for although it may be pulled out all right, something is lost, and there is generally no excuse for it.

LITTLE FEAR OF OVER-IRRIGATION.

The proper time to irrigate will vary with every product, every locality and every temperature. As a rule, one should be careful about applying water too freely when anything is in bloom. The same when fruit is ripening. But to this latter there are large exceptions, especially with berries to be sold fresh in the local market and fruit that is to be sold to the cannery or shipped but a short distance. Injuring the flavor of fruit with too much water is much exaggerated. Much of the California fruit in the eastern market is flat because picked too green, as it must be to stand the long journey. Most of the talk about its being over-irrigated is done by cranks with dry land to sell. Stuff to be shipped far and keep well should not be bloated with water. That is about all there is in it. There is very little danger in watering too often if the ground is well drained and it is not soaked too much. I have seen peaches, plums and pears made very flat and sour, as well as small, on very well drained ground. But it was because the water was running in large quantity almost all the time. I have seen several million times the quantity made small, flat and sour with too little water. Last summer, in my garden, I tried to see how much water a few peach and pear trees would stand. I failed to damage the quality and had the finest I ever saw. But they were not kept in a mud puddle. I watered them every week, but just enough to keep the soil so that it would pack into a ball readily in the hand without any mud clinging to it. It was done by frequent watering with a moderate quantity and digging three days afterward with a potato fork. It is doubtful if any fruit can be hurt as long as the soil is not muddy enough to stick to the hand. And I would rather trust to keeping the soil in that condition the whole season through than to wait for anything to show the want of water. It cannot always be done, especi-

ally on a large scale, but the more nearly you approach it the better.

In southern California peaches, apricots, prunes, and most other deciduous fruits, rarely have an "off year," and when they do it is seldom a serious shortage. This is largely due to irrigation of the trees once, and often twice, after the crop is picked. This starts the trees into a new growth before the setting of the fruit buds for the next year. The most regular, as well as the heaviest crops, are from trees thus treated, and it would be well to follow this course wherever the climate will permit a late growth in time to harden up the wood to endure the winter. This latter is a point always to be kept in mind, for there are many places where a late growth will be nipped by frosts, while in other places it will not. But this recuperation of the tree in the same season will doubtless give it a longer and healthier life, even if it does not save it from an occasional off year.

After what is above said you will see how impossible it is to say how often during the season one should water. It will vary with the soil, the climate, the age of the trees, the nature, and especially the size of the crop, the amount of hot weather, etc. In 1894 I had to irrigate a number of trees twelve times, because the rainfall of the preceding winter had been so very light and the subsoil was dry. The trees were heavily loaded, and I could get but a short run of water and a small stream. Every tree carried its fruit through in fine shape, but if I could have controlled my water supply I could have done it with four irrigations, and had the preceding winter been up to the average in rainfall two good wettings would have sufficed.

SOME GENERAL INSTRUCTIONS.

In general, it is not necessary to water as often as one would suppose, provided the ground is well soaked at each time and good cultivation is kept up. With a winter rainfall of twenty inches, the average of a highly productive and extensive area in southern California, the last rain of any value being rarely later than the 1st of May, followed by seven months of sunshine, with an air most of the time drier than is ever felt east of the Mississippi, and often intensely dry for weeks at a time, the periods of irrigation on well cultivated land run nearly as follows:

Oranges and lemons, four times a year.

(These need more water than any other trees).

Apricots, peaches and prunes, once or twice before picking and once or twice afterward. The once or twice depends much upon the nature of the soil and the ideas of the irrigator. It is the same with pears and all other deciduous fruits.

English walnuts, twice a year.

Corn—most of the corn in California is grown without irrigation, but water three times will double the crop and twice will increase it immensely. If planted straight both ways, as in the east, and well cultivated, two irrigations will more than double the yield. It is the same with beans, beets, potatoes, cabbage, peanuts, peas, and a host of things.

Alfalfa, once after each cutting. Some irrigate just before cutting. This will vary some with locality, but does not affect the rule of once at each cutting. In some places there are seven cuttings a year. Four of these will mature in five weeks from the last cutting; one more will take a trifle longer, the rest considerably longer. At two of these cuttings flooding is sometimes omitted, but seven times a year will not be too much for alfalfa raised for profit in the lands of warm winters.

It will thus be seen that irrigation is not a constant drenching of the soil, or even an attempt to pour on water as often as rain generally falls. It should be at each time what rain ought to be—enough to last until the roots have absorbed it. The quantity should be so great that surface evaporation and drainage beneath can do their worst and still leave enough to carry the plant for a period that, in the lands dependent on rain, is generally considered a drouth.

This assumes a thorough wetting of the whole ground. Where less than the whole is wet with basins or single furrows, there is no possible way of getting reliable data. But even then, two or three times a year more should suffice if the work is well done and the intermediate ground well cultivated.

LOW AVERAGE RAINFALL.

Where the rainfall is but ten inches the number of irrigations is generally increased by two more for oranges and lemons and one more for deciduous fruits. The latter are sometimes watered twice more. Lowering the rainfall to five inches would not

now make much difference, though if the air is very dry it will probably pay to add another dose of water. Reducing it to nothing would make little difference, as a five-inch rainfall for the year is practically nothing. But still, another watering would not hurt it. There is a difference between what you can do and what there is no need of doing that should be kept always in mind, if you want to make money out of the ground. Many give less than the quantities above given, but where you don't have to stint your vegetation don't do it, for, everything else being equal, the most money is steadily made by those who use the most water.

For berries, especially strawberries, and vegetables that are worthless unless crisp and succulent, no analogies like the above are of much use. They need water very often for the best results, but the soil and the weather affect the question too much to allow any rules. In hot weather, if the water, too, is warm, it would be hard work to injure strawberries with a light dose every three days, while there seems no limit to the amount radishes and cucumbers will take without injury.

The practice of irrigators, however, is not always a sure guide. It will undoubtedly pay to irrigate the olive well. I have seen it treated like the orange with stupendous results, but hardly anyone does so because it is so tough and does so much without water that it is generally left to shift for itself. The number of times a year that anything needs water will also depend somewhat on the position of the roots. If you keep a sprinkler running all the time on a lawn you train the roots so near the top that they need water almost constantly in hot weather. But if wet by the running of small streams a long time, or by good flooding, so that the water soaks in deep, the lawn will not need one-fourth of what it needs from the sprinkler, and the roots will follow the receding moisture until the grass will soon go two or three weeks in the driest weather with no sign of suffering. Where water is short it is well to train everything in this way; but where water is plenty almost everything does better with the roots in the top soil where it is richer and warmer and more accessible to air.

I considered cultivation quite fully in Chapter V. Allow no one to inform you it is not necessary. It is entirely too late in

the century for any one to tell us this. At Santa Fé last summer I was shown a fine young orchard of various trees about ten feet apart, flooded but uncultivated, and the trees in such shape that it could not well be cultivated.

"Very good for a young orchard," I replied, when pressed for an opinion.

"And what will be the matter with it for an old orchard?" asked the owner, with a touch of indignation.

"You will wish the trees were so that you can cultivate them," I replied.

"Ha! ha! ha!" he sneered; "we have to plant them close so as to shade the ground in this hot sun."

"We got over that in California fifteen years ago," I answered.

If the ground is well stirred and kept stirred there is not sun enough or heat enough in North America to rob the moisture from the soil in seven months. California proves this in thousands of places every year.

If ground is flooded and then left to bake, as this was, there is not shade enough in Erebus to keep the soil from drying out in half the time it should dry out.

But will you not get more fruit from many trees close than from fewer ones farther apart?

When young—yes; when old—no, not by several fold. And the percentage of first grade will be very light.

I was shown the old Chisum orchard at Roswell, New Mexico, on the same trip. It, too, was all uncultivated. It had a very fine crop of apples, but it simply proved that that part of New Mexico, like many other new sections, will raise very fine apples. In the course of a few years those who continue to raise apples in that

way will make considerably less money than those who cultivate. It has been so everywhere it has been tried, and with every kind of fruit. There is no reason why any section should be an exception. It is as plain as can be that the soil needs aerating as well as moistening. It is certain that good stirring will retain most all the moisture until the roots take it out; it is equally certain that it flies out rapidly under a hot sun where it is not stirred, and especially where it bakes to a hard crust after flooding. Cultivation, therefore, saves that much water and keeps the soil in a more uniform stage of moisture, which is exactly what everything needs. There is, therefore, no excuse but laziness for neglecting it, and the man who tells you it is not needed is not a benefactor, but one of those smart fools who never think about running to the patent office to see if any one has been ahead of them with their new discovery.

Cultivation after irrigation needs a machine that stirs and pulverizes instead of turning up the moisture, as a weed-killing cultivator generally does. It wants teeth instead of shovels, and plenty of them. Disks pulverize well but do not stir enough. Such a machine should be light and easily handled, and made to turn easily without injuring trees, and also easily raised or lowered to run deep or shallow, as needed. The Killefer cultivator, made at Los Angeles, has been devised expressly to meet this demand, and seems to do the work better than any other. But almost anything is better and quicker than a common shovel cultivator, such as is made for killing weeds. The other will keep the weeds out if used enough, while the shovel brings up too much moisture and runs hard.

SOME RECENT DECISIONS RELATIVE TO WATER RIGHTS.

BY CLESSON S. KINNEY, OF THE SALT LAKE CITY BAR.

IN the case of *Moyer vs. Preston*, 44 Pac. Rep., 845, the Supreme Court of Wyoming held: That the common law doctrine of the rights of riparian owners to the waters of natural streams being inapplicable to the requirement of the land owners of Wyoming, was not in force in that state. And further, that Section 1317, providing that persons owning land in Wyoming bounded on or in the neighborhood of a stream shall be entitled to the use of the water of the stream for the purpose of irrigation, does not entitle such owners to claim the water of the stream as riparian owners as against prior appropriators.

In the same case as above, the court held: That the owner of land on which was situated a spring, the waters of which were tributary to a stream flowing through the land, worked several days in 1885 clearing out that spring and facilitating the flow of the water to the stream, and in 1886 again worked one day in clearing the spring, with the intention of appropriating the waters for irrigation, no further work of appropriation being done until 1887, was not an appropriation of the water as against a person prosecuting his work of appropriation in 1886.

CLAIM OF APPROPRIATION—REASONABLE DILIGENCE—USER.

In the case of the *Nevada Ditch Company vs. Bennett*, 45 Pac. Rep., 472, decided by the Supreme Court of Oregon, the facts were as follows: In the early summer of 1881 persons claiming an appropriation of water from a public stream posted a notice at the head of the proposed ditch, as required by local custom, stating the amount of water claimed, the purposes for which it was to be applied, and the route and terminals. Work was begun shortly afterward, and a dam was built and a diversion made for the purpose of aiding in the excavation. The first section, two miles long, was completed in the spring of 1882. During 1882 the ground

was cleared for the excavation of the second section to the further terminal. In the spring of 1883 the work was prosecuted till the irrigation season, when it was stopped to permit the use of water through the completed portion. It was resumed in the fall, and continued until the completion of the second section, in the spring of 1884, and during that year water was run through the full length of the two sections, a distance of about nine miles, and used for irrigation purposes.

The action was one brought by the plaintiff above named to determine the quantity and priority of plaintiff's appropriation of water from the stream, and to restrain defendants from interfering with its use. It was held by the Supreme Court that the plaintiffs had exercised due and reasonable diligence in the prosecution of the work, and that in such a case the appropriation dates back to the first steps taken in the construction of the ditch.

It was also held that a claim to a water right ripens into a valid appropriation only when there is an actual user for a beneficial purpose, and that the claimant is entitled to a reasonable time, after he has diverted and carried the water to the place of use, in which to make the actual application to the contemplated useful purpose, using reasonable diligence under the circumstances of the case.

TRANSFER OF CLAIM.

In the case last cited it was also held that where a person who initiated the appropriation, but has not yet completed it, transfers the possessory title to which the water right was appurtenant, his successor can complete the appropriation.

And also that the *bona fide* intention which is required of the appropriator to apply the water to some useful purpose, may comprehend a use to be made by or through another person, and upon lands and possessions other than those of the appropriator.

THE DIVERSIFIED FARM

In diversified farming by irrigation lies the salvation of agriculture

The Age wants to brighten the pages of its Diversified Farm department and with this purpose in view it requests its readers everywhere to send in photographs and pictures of fields, orchards and farm homes; prize-taking horses, cattle, sheep or hogs. Also sketches or plans for convenient and commodious barns, hen houses, corncribs, etc. Sketches of labor-saving devices, such as ditch cleaners and watering troughs. A good illustration of a windmill irrigation plant is always interesting. Will you help us improve the appearance of The Age?

STRAWBERRY CULTURE UNDER IRRIGATION.

BY F. C. BARKER, OF NEW MEXICO.

THE strawberry calls for a special system of culture where irrigation is practiced. In very few localities will matted rows be successful. If the beds are flooded most soils will cake to such an extent that cultivation in the matted rows will be most difficult, if not altogether impossible. On the other hand, many soils are so deficient in porosity that the plants in the middle of the rows will be left dry if the furrow system of irrigation be followed. It is also difficult to properly mulch strawberries in the matted rows so as to keep the berries out of the mud.

The system of planting on narrow raised beds, with wide water furrows between, is popular in small gardens, as, by setting the plants just above the water line, the berries are raised above the mud. Cultivation, however, is tedious, and in the event of any scarcity of water the plants suffer terribly.

On the whole, I am inclined to favor hill culture and the flooding system of irrigation, the plants being set on the flat.

In my own case I have adopted the following method with success: The land is cleared of rubbish and lightly plowed in the late fall or early winter, and any apparent irregularities in the surface made level with the scraper. During the winter stable or cow manure, or, indeed, any kind of manure that is procurable, is carted on to the extent of not less than sixty loads per acre. This quantity may appear excessive to some farmers, but it must be borne in mind that three crops will be taken from the land before it is again fertilized. Most of my own land received more than double this quantity of manure. Wood ashes are also an excellent fertilizer,

and so are ground bones, where they can be obtained. For my own part I am a great believer in stable or farmyard manure, as it improves the mechanical condition of the soil and the humus, in which our soils are naturally deficient, is not only beneficial to the plant but it tends to hold moisture.

Having carted on your manure and spread it, plow it under and give the land the heaviest irrigation you can manage. The object of this irrigation is to rot the manure and enable you to give the final and deeper plowing. The winter irrigation will also enable your land to better stand the droughts of summer.

When the land gets sufficiently dry to work, which will be in about two or three weeks, and before it gets too hard, plow as deep as ever you can, following with a subsoiler. Then drag or harrow so as to break up clods and get the land smooth.

Now, lay out the land in small oblong beds, say not over thirty feet wide by ninety long. It will be difficult to get the water over larger beds quickly and evenly. The water must not be allowed to run from one bed to the other, but lateral ditches must be run to irrigate a row of these beds on each side, the water being let in by small boxes or water gates, say 6 x 4 inches inside measurement. Each bed must be most carefully leveled by means of a spirit level, so that there be no greater fall than two inches in ninety feet. Indeed, if absolutely level they will be all the better. This leveling is of the greatest importance; if not properly done the plants will be standing in muddy water at the lowest point and the berries ruined. The more efficient method of leveling small beds is to run a row of small stakes, the tops of which are placed on a level with the spirit level, down the middle and across. The height at which they stand above the sur-

face will at once show any inequality in the land, and this in small beds can generally be easily rectified by means of a hoe, shovel and wheelbarrow, or a horse scraper may be used.

After the beds are properly leveled give a thorough irrigation about ten or twelve days before you expect your plants. This will put the land in a proper state of moisture to receive the plants and also enable you to see if your leveling has been true. If the land allows the water to stand over an inch and a half in any place you will have to level up again. Planting will be facilitated if the land be harrowed and the surface left in good tilth after this irrigation.

In setting out the plants, take a stout cord, such as carpenters use, and of the length of your beds. At the distance of every sixteen inches mark the cord with a piece of string of a different color by inserting in the cord and tying a knot. The rows are to be sixteen inches apart, and if the cord be so placed that the rows all start on a line, and a plant set at each knot, you will have your plants running in straight lines and at a distance of sixteen inches each way. This is to enable you to cultivate each way, using a Planet, junior, hand or wheel hoe, two of which will cultivate very nearly as many plants in a day as will a horse, and at no more expense. It is true the horse will get over much more land, but the plants will have to be thirty inches each way, and he will never do such careful and thorough work as the man. These wheel hoes are quite indispensable on any strawberry or vegetable farm.

Plant the front row sixteen inches from the border. Then plant two rows and miss a row; then plant four rows and miss a row, and so continue across the bed. If your beds are thirty feet across, or say twenty-eight feet clear of the borders, you will have two rows at each side and three beds of four rows each in the center, with four alleys thirty-two inches wide to enable you to get at the berries, when you want to pick them. Each bed will take 1,056 plants, or 17,000 to the acre.

In planting, I have found nothing equal to a spade. It is thrust into the ground its full length and the handle pushed about a foot away from the worker, which leaves a most convenient wedged-shaped hole for the plant, against the upright

side of which the roots can be easily spread. It is six times faster and more efficient than a trowel.

Subsequent cultivation consists in keeping the soil at the roots constantly moist, but not too wet, and giving a cultivation after each irrigation with the wheel hoe. An occasional hand-hoeing will be necessary where weeds are growing too near the plants to be reached by the wheel hoe, and of course all runners must be kept off the plants, and just before the fruit appears a mulch of straw, or some other suitable material, must be laid between the rows in order to keep the berries out of the mud.

PRACTICAL VALUE OF SPRAYING.

At a recent meeting of the Western New York Horticultural Society, in Rochester, the following experience was recited:

Mr. Albert Wood, of Orleans county, said he had an apple orchard of twenty-five acres on a gravelly loam. The trees were too close at two rods apart. The shaded ground became mossy; the red apples showed little color. He went through the orchard and cut out every other tree six years ago, since which time he has cultivated and fed those that were left. In 1893 he sprayed two trees; on these the apples were good, while most of the others went to the dry house. On the 20th of April, 1894, he sprayed his orchard, except fourteen trees left for comparison, with twenty pounds of copper sulphate, four pails of lime and 150 gallons of water. He sprayed again as the buds were swelling, and again when the apples were half an inch in diameter. About this time the apples on the unsprayed trees began to drop. With the last two sprayings he used Paris green—one pound to each 150 gallons of water. On the fourteen trees not treated the foliage was rusty. The thirty-five barrels of fruit he picked from them shrunk five barrels between picking and selling. Of the 2,000 barrels of treated fruit the shrinkage was not five barrels in the same time, and they brought thirty-eight cents more a barrel. On a strawberry apple tree that had not had a perfect apple in nine years, every apple was sound. Similar results were had with King, Baldwin and Twenty ounce trees. Of Roxbury russets three-fourths of the untreated apples were ground for cider, while most of those treated were good. Roxburys should have five sprayings a season.

Pears were treated in the same way as the apples. Some Virgalieus had borne no perfect fruit for twenty-five years, and this year, when sprayed, there was no imperfect fruit. His results showed ninety per cent. gain by spraying. In a young orchard-row not treated the leaves fell three weeks earlier, and the foliage was not as heavy as on the sprayed trees. He had similar results with treated and untreated cherry and plum trees. From Fay's currants which had been sprayed he picked fruit twenty days

after others were gone. He thought the Bordeaux mixture should be applied as a mist, and that the Vermorel nozzle was best except for the higher trees, where the McGowan was the best. A tree should be sprayed till it drips. You cannot throw Bordeaux mixture far when reduced to a fog, and, therefore, for large trees long bamboo poles must be used to hold the nozzle close to the foliage. He used 900 pounds of copper sulphate for thirty days' spraying.

PHYLOXERA IN THE SOUTH AFRICAN VINEYARD.

A CORRESPONDENT writing from Stellenbosch, Cape Colony, South Africa, to an Australian contemporary, says:

About \$70,000 cuttings of American vines will arrive here in the course of next month, to be distributed among the vine-growing population. Phylloxera spreads without any intermission, the devastations are so vast as to be almost beyond belief; some infections exist where the vines die off by thousands. It is a pleasure, though, to write of the great successes obtained in the grafting of vines which develop with unexpected rapidity. I have obtained with green grafting most astonishing results; those grafts, the stocks of which were planted last year as unrooted cuttings, are now over five feet high, and have five and even more well developed bunches of grapes to show. It is still more astonishing that they are on the site where the old vineyard died out, and the new plantation took its place at once.

BISMARCK TO THE FARMERS.

BISMARCK must have taken to farming for profit since the emperor relieved him as chancellor. At a recent meeting of German agrarians the old emperor-maker is reported to have said:

Husbandry is the first-born, but it is not the most favored trade, because farmers cannot live in the towns, and consequently they have not much influence in making the laws. We must stand shoulder to shoulder against the drones who govern us and produce nothing but laws.

A *Red Cedar Log*, twenty-three inches in diameter, is reported to have been penetrated by a well auger near Lytle Creek, San Bernardino county, Cal., recently, at a depth of 194 feet. Another tree of the same kind was found sixteen feet further down, or at a depth of 210 feet below the surface. No red cedar is now growing anywhere in the county.

World's Commerce.—From a bulletin of the Department of Agriculture concern-

ing the world's markets for American products, we learn that the present commercial rank of nations is as follows: United Kingdom, United States, Germany, France. The foreign commerce of the United Kingdom is about equal to that of the United States and Germany combined, while the difference between the trade of the United States, Germany and France is not very great, the countries ranking in the order named.

Machinery and the Employed.—No doubt the prevailing belief is that the advent of machinery in almost every department of human industry has had the effect to reduce the percentage of persons engaged in gainful occupations, relatively to the whole mass of people. Col. Carroll D. Wright finds, however, by a careful study of statistics that such is not the case. Thus, he finds an actual increase of over 11 per cent. in the thirty years—1860-1890.

The Althouse Valley in southwestern Oregon is a well irrigated section, largely devoted to the production of hay. Comparatively little grain is grown there, but fruits, garden truck and hay always command good prices at the various mining camps in the vicinity. That part of the state has long been known as a rich gold placer mining region, and considerable activity is manifest in the development of mining enterprises.

Growing Tea.—Dr. Shepard, of Pinehurst, South Carolina, has about forty acres devoted to tea plants, according to a writer in the *Country Gentleman*. The plant, as grown by Dr. Shepard, is a shrub about three feet high, and the plants are placed in rows about six feet apart.

Good Roads.—Col. F. V. Greene, of the army, in an address at Union College recently, alleged that Massachusetts expends at the rate of \$66 per mile on her wagon roads each year; New Jersey \$43 and New York \$30. Colonel Greene estimates that the other states expend an average of \$18 per mile on their wagon roads, or a total of \$20,000,000 annually, a large part of which is wasted.

Not Self-Supporting.—Doubtless the farmers of Indiana have been too busy raising wheat for the Liverpool market in competition with the peons of Argentina to bother themselves with providing a home supply of cabbage and potatoes. In this connection the Indiana Farmer says:

It is well to repeat the fact to our readers that we are importing altogether too much produce from other states into Indiana. A few days ago one of our commission firms received a car load of cabbage from Maine, two car loads of potatoes from Michigan and one each from two other states. We surely ought to grow enough vegetables for our own use. Potatoes seldom fall below a paying price here, and there seems to be no valid reason why our farmers should not grow at least enough for home supply.

A Well-Known Horseman has discovered a fact in natural history which may not be generally known. It is that all four-footed beasts, in making the first movement in walking, running, or any sort of forward motion, always employ the left hind leg as a starter. Even a child, if put down on all fours and bidden to advance in that position, will make the first move with his left leg, his hands at the same time occupying the place of an animal's forelegs, says the Southern Stock Farm.

Apple Borers.—The Canadian Horticulturist gives the following remedy for apple tree borers:

When borers get into a tree there is no other remedy than cutting them out with a sharp knife, or killing them in their burrows with a stout wire. But prevention is better than remedy, and the injury from borers can easily be prevented. To do so, wash the trunks and larger branches with a mixture of soft soap reduced to the consistency of thick paint with a solution of washing soda. If just enough carbolic acid is added to give it a strong smell it will be all the more repulsive to the beetles. This should be applied during the early part of June and again early in July, when the beetles are most active in laying their eggs.

New Prolific is the name of a peach of recent introduction in Michigan, and is alleged to be very hardy and a liberal bearer. Mr. G. R. Agnew, of Erie, Mich., recommends it highly, and says that his future plantings will comprise 60 per cent. New Prolifics.

South Dakota can raise wheat at a cost of \$8.75 an acre, including \$1.52 for ground rent, which is lower than in any other State. Yet in that State the average crop will not pay that cost at present selling prices.

Foreign lemons are being shipped into New York in such quantities and are selling so cheaply that the California growers have abandoned the Atlantic coast markets and will push their sales in the interior West.

There were 63,485,413 passengers carried over the 10,500 miles of railway in Illinois last year, with a loss of only twelve lives, or one out of 5,290,451. The number injured was as one to 409,583.

Mexico shipped four hundred carloads of oranges to the United States last year, and six hundred loads during the season just ended. The loss of the Florida trees made this possible.

It requires 15,000,000 cows to supply the demand for milk and its products in this country, and the products of 60,000,000 acres of land to feed them.

In 1830 the whole tonnage of Great Britain was but 2,600,000. To-day the tonnage register shows 6,000,000 tons of steam and 5,000,000 tons of sailing vessels.

Delaware has the largest peach crop since 1875, about 6,000,000 baskets, and growers have offered them as low as 25 cents a basket.

Montana heads the list this year as to the number of sheep, followed by California, Ohio and New Mexico in the order named.

The State farms in North Carolina, where the convicts are employed, have 5,000 acres in corn and 4,000 acres in cotton.

The number of sheep in the country has decreased in the last two years from 55,000,000 to less than 43,000,000 head.

There are more than 500,000 telephones in use in the United States, and they are used more than 2,000,000 times daily.

The consumption of cheese is apparently decreasing. It is held to be a luxury, and the hard times tells against it.

Vessels drawing twenty-three feet of water can now enter Sabine harbor with perfect ease and safety.

PULSE OF THE IRRIGATION INDUSTRY

IMMIGRATION AND IRRIGATION.

BY BENJ. W. THOMPSON.

IN the August number of *THE IRRIGATION AGE* the relation of these factors to each other was tersely stated in two or three sentences.

It is quite surprising that in actual practice it has required a succession of disastrous experiences to make men see that irrigation without prompt and extended settlement of the lands leads directly to failure.

Immigration from the old world has been greatly foreshortened by the depressed condition of the country since 1893.

The same cause has stimulated the desire to change place among our resident American people, but it has also prevented large migrations to irrigated lands, because people have been entirely unable to realize cash for their possessions and so could not move.

Settlers upon irrigated lands require at least a small amount of capital and some knowledge of that class of farming.

Hence the question of ability to people the new areas with suitable tillers of the soil is becoming prominent in every new and unfinished canal proposition.

The cautious capitalist is coming to understand the relation of this factor to success or failure and new enterprises will have to demonstrate their ability to provide population before they can borrow money to build.

There have been some examples in Arizona which may contain instructive lessons for coming canal promoters and builders.

The Florence canal was built in good times by parties with money and ability to borrow. The land covered, known as the Casa Grande Valley, is very excellent in quality and much of it ideally located for irrigation. Florence was a growing town and the lands under the canal reached to the Southern Pacific railroad, giving them an outlet. The canal was completed and put in operation while the country was prosperous.

But in a short time it failed, bringing ruin upon its principal owners because its

income was insufficient to pay its fixed charges and expenses.

The reason of the failure seems very plain. No adequate effort was made to procure settlers for the lands. The projectors seem to have taken it for granted that people would rush in and take up the lands as soon as it was known that they could be irrigated.

It is quite probable that this would have been true if the public had been thoroughly informed by judicious advertising of the advantages of this new field.

In the absence of this information the general public practically knew nothing of this new canal and took no interest in its lands.

The Arizona canal in the Salt River Valley, Arizona, was built earlier than the Florence. The lands under it were all taken up by the time the canal was finished.

Through the operation of the very liberal desert land law of that time quite a large proportion of these lands came into the hands of the principal owners of the canal stock. The canal became to this extent a private land speculation.

The withholding of so large a portion of the lands from profitable contribution to the fixed charges and expenses of the canal retarded its growth and debt paying power. In times of damages from floods they were compelled to borrow and draw from personal resources to meet emergencies.

Because of the near location of the lands to the large town of Phoenix, of good times which prevailed for six or seven years after its completion, the principal owners were able to carry the load and sell quite an amount of the lands at a handsome advance on their cost.

The experience, however, was a hazardous one, and at other times and circumstances might readily have ended very unfavorably.

The co-operative canals of the Mormon's on the south side of the Salt River were built upon a plan which combined safety and success with entire fairness and justice to all parties interested.

These people, after discovery of the place and deciding to build, sent forward their men and teams with a few families to board the workers, and began the work. A part of the teams procured work from the government hauling supplies and wood to Fort McDowell and so furnished the ready money for such supplies as had to be bought for cash. Putting a brush and stone dam into the river they soon had a small supply of water and began to raise their food and forage. The population was increased as rapidly as there was room for them, a certain portion being kept at work upon the canal.

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B. H. BARROWS,
Librarian Public Library, Omaha, Neb.

You do indeed publish a nice looking and very interesting monthly, and I think it fills a long-felt want, and will help to solve the problem of population and immigration for Nebraska and the central West.

GEO. P. BEMIS,
Ex-Mayor of Omaha, Neb.

I highly appreciate the good work THE AGE has done, the contents of which I have always valued.

E. W. BLACK,
North Loup, Neb.

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THE IRRIGATION AGE is indispensable and is a very valuable paper. DR. J. B. BURNS,
Plymouth Colony, Payette, Idaho.

I consider your work the best thing in its line that I have ever seen, and I hope you will be able to continue on the lines already established by your publication. Every man interested in irrigation should read THE AGE.

WM. BUTTON,
Minneapolis, Minn.

I hope you will meet the success your truly valuable paper deserves.

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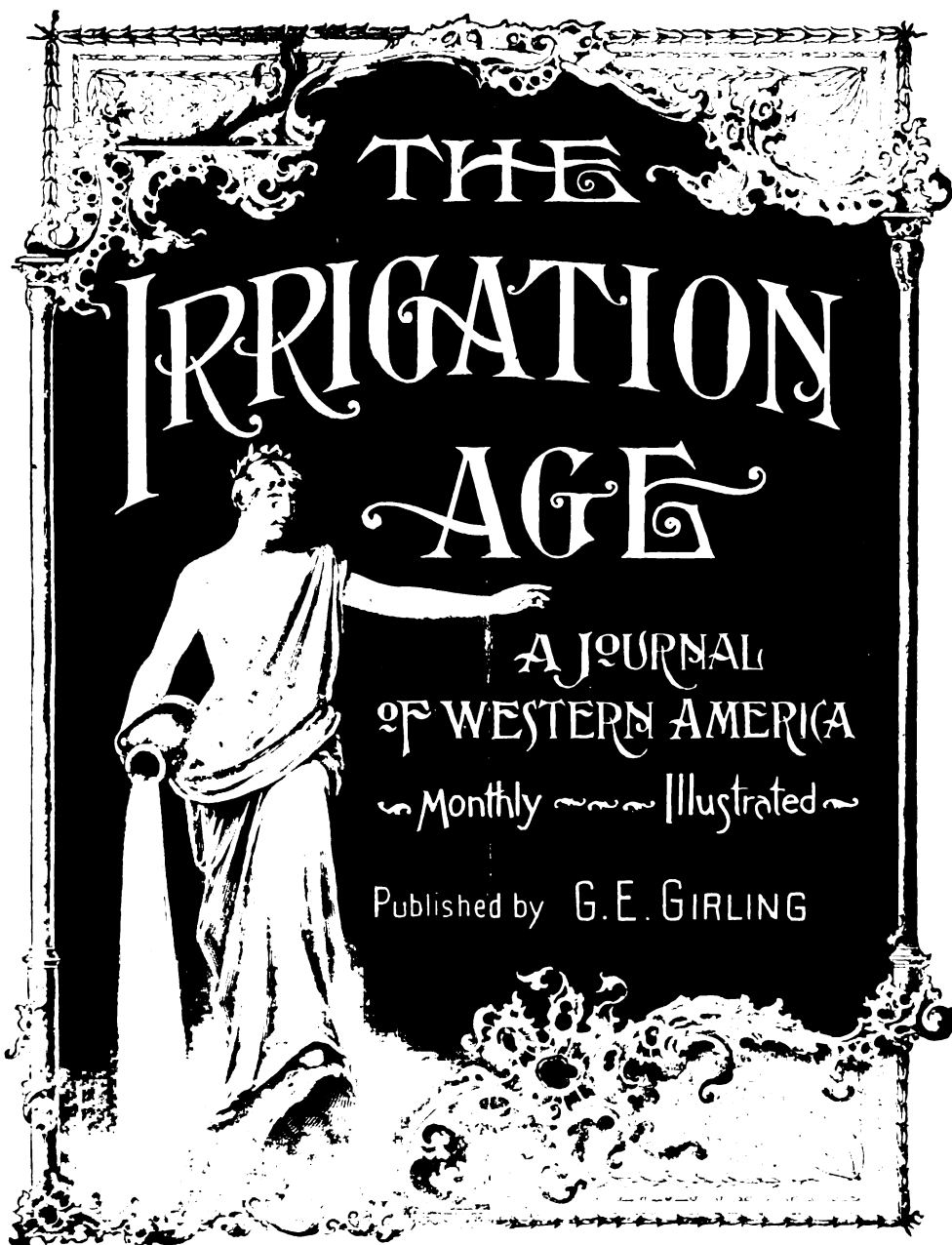
NOVEMBER, 1896

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VOL. X.

No. 5.

THE HOMESEKERS ASSOCIATION AND ITS WORK.



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A THREE-YEAR-OLD APPLE TREE IN THE PECOS VALLEY.

Soil, Climate and Productions.

The soil of the Pecos Valley is, in the main, a sandy loam, and is of remarkable depth and richness. The climate is warm and sunny, practically winterless, with long growing seasons, and likewise possesses wonderful health-giving and health-restoring properties, especially for pulmonary and many other chronic diseases. This soil and climate, with the abundant water supply, unite to produce bountiful crops of all the grains, grasses, berries, vegetables and fruits of the temperate zone. Such forage crops as alfalfa, sorghum, Indian and Egyptian corn grow most luxuriantly, making the feeding of cattle, sheep and hogs a most profitable industry. The sugar beet attains a perfection not reached elsewhere in the

United States, if in the world. A beet sugar factory, with a daily capacity of 225 tons of beets, is now being built at Eddy, and will be in operation November 1, 1896. To supply this factory the farmers of the Valley are now putting in fully 2,500 acres of beets, for which the sugar factory has contracted to pay \$4 per ton delivered at any station on the Pecos Valley Railway, the company paying the freight to the factory. At this price, and with the large yield per acre in the Pecos Valley, the farmer should clear all the way from \$35 to \$75 per acre from his crop of beets.

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Social and Educational.

The Pecos Valley is being settled in the main by progressive and intelligent people, the majority being Americans, mainly from the Central West. As a result, schools and churches are found in every town and village in the Valley.

The Pecos Valley, while attracting the general farmer and fruit-grower, holds especial attractions for those whose health requires an outdoor life in the dry, elevated region of the Rocky Mountain plateau; and these will there find not only the health they seek, but profitable occupation as well. Not only does this life appeal to the health-seeker, but also to the thousands all over our land, and especially in our large cities, who wish to exchange the life of grind and drudgery and narrowing industrial conditions, for one of independence and a larger hope for the future.

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(ADVERTISING SUPPLEMENT.)

MOUNT SHASTA IN CALIFORNIA
On the lip of the Southern Pacific.

THE IRRIGATION AGE.

VOL. X.

CHICAGO, NOVEMBER, 1896.

NO. 5.

PROGRESS OF WESTERN AMERICA.

The Wright Law Decision rendered. The all important decision on the constitutionality of the Wright Irrigation District Law has been rendered, and as this comes from the Supreme Court of the United States there can be no further dispute as to main points of the law, that the use of water for irrigation is a public use. The decision in the case of the Fallbrook Irrigation District vs. Maria King Bradley, et al. has been awaited with great anxiety for many months. After passing out of the jurisdiction of the State Courts it was taken to the United States Supreme Court on a question of constitutionality and attracted wide attention among Eastern people, who were just beginning to realize the importance of irrigation, on account of ex-President Harrison delivering an argument in its favor. The case was closed about a year ago and the decision expected immediately but through some peculiarity of the Supreme Court it has been withheld. It is a matter affecting bonds with a face value of about ten millions of dollars, and applies not only to California but to many other states, which followed California's lead and adopted the district system.

The Decision. A portion of the decision as rendered by Justice Peckham on November 16 follows:

To provide for the irrigation of lands in states where there is no color of necessity therefor, within any fair meaning of the term, and simply for the purpose of gratifying the taste of the owner, or his desire to enter upon the cultivation of an entirely new kind of crop, not necessary for the purpose of rendering the ordinary cultivation of land reasonably remunerative, might be regarded by the courts as an improper exercise of legislative will, and the use might not be held to be public in any con-

stitutional sense, no matter how many owners were interested in the scheme.

On the other hand, in a state like California, which confessedly embraces millions of acres of arid lands, an act of the legislature providing for their irrigation might well be regarded as an act devoting the water to a public use, and therefore as a valid exercise of the legislative power. The people of California and the members of her legislature must in the nature of things be more familiar with the facts and circumstances which surround the subject, and with the necessities and the occasion for the irrigation of the lands, than anyone who is a stranger to her soil. This knowledge and familiarity must have their due weight with the state courts, which are to pass upon the question of public use in the light of the facts which surround the subject in their own state.

California State Courts Upheld. For these reasons, while not regarding the matter as concluded by these various declarations and acts and decisions of the people and courts of California, yet we, in consideration of the subject, accord to and treat them with very great respect and we regard the decisions as embodying the deliberate judgment and matured thought of the courts of that state on this question. Viewing the subject for ourselves and in the light of these circumstances, we have very little difficulty in coming to the same conclusion reached by the courts in California. The use must be regarded as a public use or else it would seem to follow that no general scheme of irrigation can be formed or carried into effect.

To irrigate and thus to bring into possible cultivation these large masses of otherwise worthless lands would seem to be a public purpose and a matter of public interest; not confined to the land owner, or even to any one section of the state. The fact that the use of water is limited to the land owner is not, therefore, a fatal objection to the legislation. It is not essential that the entire community, or even any considerable portion thereof, should directly enjoy or participate in an improvement in order to constitute a public use. All land owners in the district have the right to a proportionate share of the water, and no land owner is favored above his fellow in his right to the use of the

water. It is not necessary, in order that the use should be public, that every resident in the district should have the right to use of the water.

The method of assessment here provided for may not have been the best which could have been adopted in order to accomplish the most equal and exact justice which the nature of the case permits. But, nevertheless, we are unable to see that it runs counter to any provision of the federal constitution, and we must for that reason hold the objection here considered to be untenable.

The Final Outcome. Owing to the very late date in the month when the decision was handed down it is impossible in this issue of *THE AGE* to review the matter as fully as would have been liked, but it may safely be stated that the end of the difficulty has not yet been reached. The opponents of the law will undoubtedly make an earnest effort to erase the law from the statute books of California and thus prevent the organization of any new districts, and there is also to be considered the difficulties the bondholders will meet in attempting to realize on the obligations they hold. The opinions of the most active workers in behalf of the irrigation cause will be presented in the next number.

Judge Ross on Water Rights. But while considering the great importance of the decision on the Wright Law, the equally important decision of Judge Ross of California on the question of water right must not be overlooked. In the case of Charles D. Lanning receiver of the San Diego Land and Town Company vs. H. S. Osborne, Judge Ross decided that where water has once been devoted to public use the right of the supervisors under the Constitution to fix water rates cannot be affected by private contract. A few extracts from the lengthy opinion are given herewith, but stripped of its legal phrases and technicalities it means that irrigation and canal companies are not privileged to sell water rights, but can demand only a reasonable compensation for the actual transportation and delivery of the water to users, in other words they may make an annual charge per acre for water delivered, but cannot exact a bonus for the right to have that water delivered. This decision, if upheld by the United States Supreme Court where it will undoubtedly be carried (as was Judge Ross's decision on the Wright Law), will remove the matter of irrigation from the

field of speculation and make it an every day business enterprise, in which the individuals and corporations who build, own and operate canals can expect only a fair rate of interest upon the investment; while the immediate effect of the decision will be to prevent the inception of new enterprises and possibly the completion of some already begun, its ultimate effect cannot but fail to be beneficial.

Extracts from California Constitution. At the time of the adoption and taking effect of the Constitution of California of 1879, the provisions of Section 552 of the Civil Code of that State were, and yet are, as follows:

"Whenever any corporation, organized under the laws of this State, furnishes water to irrigate lands which said corporation has sold, the right to the flow and use of said water is and shall remain a perpetual easement to the land so sold, at such rates and terms as may be established by said corporation in pursuance of law. And whenever any person who is cultivating land on the line and within the flow of any ditch owned by such corporation, has been furnished water by it with which to irrigate his land, such person shall be entitled to the continued use of said water, upon the same terms as those who have purchased their land of the corporation."

Sections 1 and 3 of Article XIV of the Constitution of 1879 are as follows:

Section 1. The use of all water now appropriated or that may hereafter be appropriated, for sale, rental or distribution, is hereby declared to be a public use, and subject to the regulation and control of the State, in the manner to be prescribed by law; provided, that the rates of recompensation to be collected by any person, company or corporation in this State for the use of water supplied to any city and county, or city or town, or the inhabitants thereof, shall be fixed, annually, by the Board of Supervisors, or city or county, or city or town council, or other governing body of such city and county, or city or town, by ordinance or otherwise, in the manner that other ordinances or legislative acts or resolutions are passed by such body, and shall continue in force for one year, and no longer. Such ordinance or resolutions shall be passed in the month of February of each year, and take effect on the 1st day of July thereafter. Any board or body failing to pass the necessary ordinances or resolutions fixing water rates, where necessary, within such time, shall be subject to peremptory process to compel action at the suit of any party interested, and shall be liable to such further processes and penalties as the Legislature may prescribe. Any person, company, or corporation collecting water rates in any city and county, or city or town in this State, otherwise than as so established, shall forfeit the franchises and waterworks of such person, company, or corporation to the city and

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THE AGE has been a welcome visitor at the public library for some time, and is highly valued by all our patrons.

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I highly appreciate the good work THE AGE has done, the contents of which I have always valued.

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I hasten to send you \$1 for renewal of my subscription to THE AGE, as I am well pleased with it, and also much interested in windmill irrigation on the plains. I firmly believe that it is our only way toward a successful solution of permanently settling this section of Kansas, as well as many other sections of the plains country.

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I have enjoyed THE AGE very much, and would not do without it for four times its cost.

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I consider your work the best thing in its line that I have ever seen, and I hope you will be able to continue on the lines already established by your publication. Every man interested in irrigation should read THE AGE.

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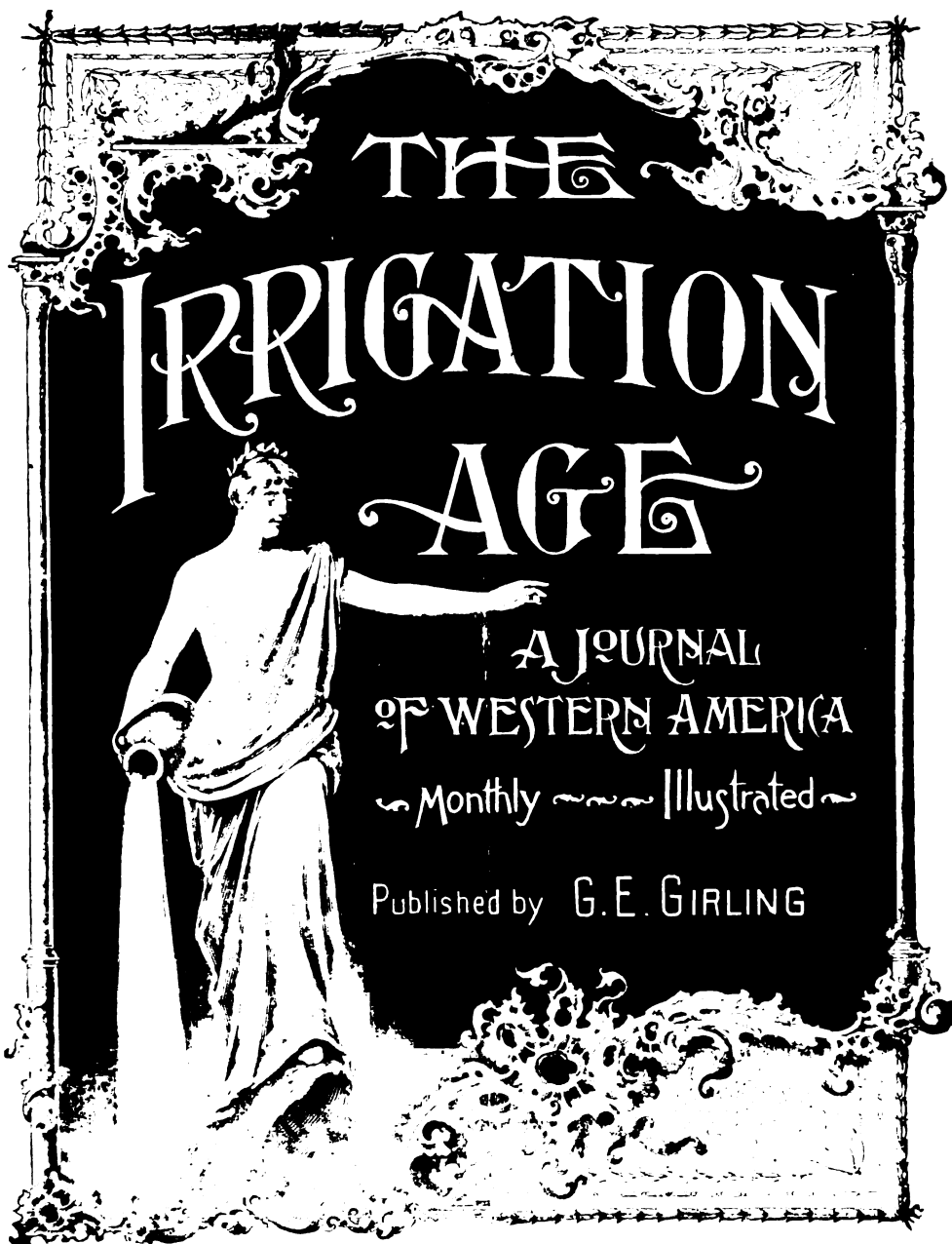
NOVEMBER, 1896

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VOL. X.

No. 5.

THE HOMESEKERS ASSOCIATION AND ITS WORK.



THE WRIGHT LAW DECLARED CONSTITUTIONAL.

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United States, if in the world. A beet sugar factory, with a daily capacity of 225 tons of beets, is now being built at Eddy, and will be in operation November 1, 1896. To supply this factory the farmers of the Valley are now putting in fully 2,500 acres of beets, for which the sugar factory has contracted to pay \$4 per ton delivered at any station on the Pecos Valley Railway, the company paying the freight to the factory. At this price, and with the large yield per acre in the Pecos Valley, the farmer should clear all the way from \$35 to \$75 per acre from his crop of beets.

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zone are successfully raised, while several of these attain a perfection rarely equaled and nowhere surpassed. At the head stand the apple and pear, closely followed by the peach, grape, nectarine, apricot, plum, prune and quince. All the small fruits grow in abundance. The fruits of the Pecos Valley are without blemish, superb in form and coloring, and of unequalled flavor. In a few years they will be found in all the great markets of the country, commanding topmost prices because of their beauty and perfection.

Social and Educational.

The Pecos Valley is being settled in the main by progressive and intelligent people, the majority being Americans, mainly from the Central West. As a result, schools and churches are found in every town and village in the Valley.

The Pecos Valley, while attracting the general farmer and fruit-grower, holds especial attractions for those whose health requires an outdoor life in the dry, elevated region of the Rocky Mountain plateau; and these will there find not only the health they seek, but profitable occupation as well. Not only does this life appeal to the health-seeker, but also to the thousands all over our land, and especially in our large cities, who wish to exchange the life of grind and drudgery and narrowing industrial conditions, for one of independence and a larger hope for the future.

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THE IRRIGATION AGE.

VOL. X.

CHICAGO, NOVEMBER, 1896.

NO. 5.

PROGRESS OF WESTERN AMERICA.

The Wright Law Decision rendered. The all important decision on the constitutionality of the Wright Irrigation District Law has been rendered, and as this comes from the Supreme Court of the United States there can be no further dispute as to main points of the law, that the use of water for irrigation is a public use. The decision in the case of the Fallbrook Irrigation District vs. Maria King Bradley, et al. has been awaited with great anxiety for many months. After passing out of the jurisdiction of the State Courts it was taken to the United States Supreme Court on a question of constitutionality and attracted wide attention among Eastern people, who were just beginning to realize the importance of irrigation, on account of ex-President Harrison delivering an argument in its favor. The case was closed about a year ago and the decision expected immediately but through some peculiarity of the Supreme Court it has been withheld. It is a matter affecting bonds with a face value of about ten millions of dollars, and applies not only to California but to many other states, which followed California's lead and adopted the district system.

The Decision. A portion of the decision as rendered by Justice Peckham on November 16 follows:

To provide for the irrigation of lands in states where there is no color of necessity therefor, within any fair meaning of the term, and simply for the purpose of gratifying the taste of the owner, or his desire to enter upon the cultivation of an entirely new kind of crop, not necessary for the purpose of rendering the ordinary cultivation of land reasonably remunerative, might be regarded by the courts as an improper exercise of legislative will, and the use might not be held to be public in any con-

stitutional sense, no matter how many owners were interested in the scheme.

On the other hand, in a state like California, which confessedly embraces millions of acres of arid lands, an act of the legislature providing for their irrigation might well be regarded as an act devoting the water to a public use, and therefore as a valid exercise of the legislative power. The people of California and the members of her legislature must in the nature of things be more familiar with the facts and circumstances which surround the subject, and with the necessities and the occasion for the irrigation of the lands, than anyone who is a stranger to her soil. This knowledge and familiarity must have their due weight with the state courts, which are to pass upon the question of public use in the light of the facts which surround the subject in their own state.

California State Courts Upheld. For these reasons, while not regarding the matter as concluded by these various declarations and acts and decisions of the people and courts of California, yet we, in consideration of the subject, accord to and treat them with very great respect and we regard the decisions as embodying the deliberate judgment and matured thought of the courts of that state on this question. Viewing the subject for ourselves and in the light of these circumstances, we have very little difficulty in coming to the same conclusion reached by the courts in California. The use must be regarded as a public use or else it would seem to follow that no general scheme of irrigation can be formed or carried into effect.

To irrigate and thus to bring into possible cultivation these large masses of otherwise worthless lands would seem to be a public purpose and a matter of public interest; not confined to the land owner, or even to any one section of the state. The fact that the use of water is limited to the land owner is not, therefore, a fatal objection to the legislation. It is not essential that the entire community, or even any considerable portion thereof, should directly enjoy or participate in an improvement in order to constitute a public use. All land owners in the district have the right to a proportionate share of the water, and no land owner is favored above his fellow in his right to the use of the

water. It is not necessary, in order that the use should be public, that every resident in the district should have the right to use of the water.

The method of assessment here provided for may not have been the best which could have been adopted in order to accomplish the most equal and exact justice which the nature of the case permits. But, nevertheless, we are unable to see that it runs counter to any provision of the federal constitution, and we must for that reason hold the objection here considered to be untenable.

The Final Outcome. Owing to the very late date in the month when the decision was handed down it is impossible in this issue of *THE AGE* to review the matter as fully as would have been liked, but it may safely be stated that the end of the difficulty has not yet been reached. The opponents of the law will undoubtedly make an earnest effort to erase the law from the statute books of California and thus prevent the organization of any new districts, and there is also to be considered the difficulties the bondholders will meet in attempting to realize on the obligations they hold. The opinions of the most active workers in behalf of the irrigation cause will be presented in the next number.

Judge Ross on Water Rights. But while considering the great importance of the decision on the Wright Law, the equally important decision of Judge Ross of California on the question of water right must not be overlooked. In the case of Charles D. Lanning receiver of the San Diego Land and Town Company vs. H. S. Osborne, Judge Ross decided that where water has once been devoted to public use the right of the supervisors under the Constitution to fix water rates cannot be affected by private contract. A few extracts from the lengthy opinion are given herewith, but stripped of its legal phrases and technicalities it means that irrigation and canal companies are not privileged to sell water rights, but can demand only a reasonable compensation for the actual transportation and delivery of the water to users, in other words they may make an annual charge per acre for water delivered, but cannot exact a bonus for the right to have that water delivered. This decision, if upheld by the United States Supreme Court where it will undoubtedly be carried (as was Judge Ross's decision on the Wright Law), will remove the matter of irrigation from the

field of speculation and make it an every day business enterprise, in which the individuals and corporations who build, own and operate canals can expect only a fair rate of interest upon the investment; while the immediate effect of the decision will be to prevent the inception of new enterprises and possibly the completion of some already begun, its ultimate effect cannot but fail to be beneficial.

Extracts from California Constitution. At the time of the adoption and taking effect of the Constitution of California of 1879, the provisions of Section 552 of the Civil Code of that State were, and yet are, as follows:

"Whenever any corporation, organized under the laws of this State, furnishes water to irrigate lands which said corporation has sold, the right to the flow and use of said water is and shall remain a perpetual easement to the land so sold, at such rates and terms as may be established by said corporation in pursuance of law. And whenever any person who is cultivating land on the line and within the flow of any ditch owned by such corporation, has been furnished water by it with which to irrigate his land, such person shall be entitled to the continued use of said water, upon the same terms as those who have purchased their land of the corporation."

Sections 1 and 3 of Article XIV of the Constitution of 1879 are as follows:

Section 1. The use of all water now appropriated or that may hereafter be appropriated, for sale, rental or distribution, is hereby declared to be a public use, and subject to the regulation and control of the State, in the manner to be prescribed by law; provided, that the rates of recompensation to be collected by any person, company or corporation in this State for the use of water supplied to any city and county, or city or town, or the inhabitants thereof, shall be fixed, annually, by the Board of Supervisors, or city or county, or city or town council, or other governing body of such city and county, or city or town, by ordinance or otherwise, in the manner that other ordinances or legislative acts or resolutions are passed by such body, and shall continue in force for one year, and no longer. Such ordinance or resolutions shall be passed in the month of February of each year, and take effect on the 1st day of July thereafter. Any board or body failing to pass the necessary ordinances or resolutions fixing water rates, where necessary, within such time, shall be subject to peremptory process to compel action at the suit of any party interested, and shall be liable to such further processes and penalties as the Legislature may prescribe. Any person, company, or corporation collecting water rates in any city and county, or city or town in this State, otherwise than as so established, shall forfeit the franchises and waterworks of such person, company, or corporation to the city and

DRYING PRUNES IN CALIFORNIA.

county or city or town where the same are collected, for public use.

Sec. 2. The right to collect rates of compensation for the use of water supplied to any county, city and county, or town, or the inhabitants thereof, is a franchise, and cannot be exercised except by authority of and in the manner prescribed by law."

Water Right Charge

The late case of San Diego Land and Town Company vs. City of National City decided by this court and reported in 74 Fed. Rep., p. 79, presented the question, among others, whether that company had the legal right to demand and receive a sum of money, in addition to the annual rates it was authorized to charge, as a condition upon which it would furnish water appropriated by it under the Constitution and laws of California, to the persons for whose use the appropriation was made. The thing for which that company demanded a sum of money, in addition to the annual rates it was by law authorized to charge, it designated as a "water right." In that case, this court said: "It does not change the essence of the thing for which the complainant demands a sum of money to call it a 'water right,' or to say, as it does, that the charge is imposed for the purpose of reimbursing complainant in part for the outlay to which it has been subjected. It is demanding a sum of money for doing what the constitution and laws of California authorized it to appropriate water within its limits, conferred upon it the great power of eminent domain, and the franchise to distribute and sell the water so appropriated, not only to those needing it for purposes of irrigation, but also to the cities and towns, and their inhabitants, within its flow; for which it was given the right to charge rates to be established by law, and nothing else. No authority can anywhere be found for any charge for the so-called 'water right.' The State permitted the water in question to be appropriated for distribution and sale, for purposes of irrigation, and for domestic and other beneficial uses; conferring upon the appropriator the great powers mentioned and compensating it for its outlay by the fixed annual rates. The complainant was not obliged to avail itself of the offer of the State, but, choosing, as it did, to accept the benefits conferred by the constitution and laws of California, it accepted them charged with the corresponding burden. Appropriating, as it did, the water in question for distribution and sale, it thereupon became, according to the express declaration of the Constitution, charged with a public use. 'Whenever,' said the Supreme Court of California, in *McCrary vs. Beaudry*, (67 Cal., 120, 121, 7 Pac. 264,) 'water is appropriated for distribution and sale, the public has a right to use it; that is, each member of the community, by paying the rate fixed for supplying it, has a right to use a reasonable quantity of it in a reasonable manner. Water appropriated for distribution and sale is *ipso facto* devoted to a public use, which is inconsistent with the right of the person so appropriating it to exercise the same control over it that he might have exercised if he had never so appropriated it.'"

A Similar Case in Colorado. A similar question did arise in the Supreme Court of Colorado in the case of *Wheeler vs. Northern Colorado Irrigating Company*, (17 Pac. Rep., 487,) and was there decided in precise accord with the ruling of this court in *San Diego Land and Town Company vs. The City of National City* (supra.). The provisions of the Constitution of Colorado were at the time the case cited arose, as follows:

"Sec. 5. The water of every natural stream not heretofore appropriated within the State of Colorado is hereby declared to be the property of the public, and the same is dedicated to the use of the people of the State, subject to appropriation as hereinafter provided.

Sec. 6. The right to divert unappropriated waters of any natural stream to beneficial uses shall never be denied. Priority of appropriation shall give the better right as between those using the water for the same purpose; but when the waters of any natural stream are not sufficient for the service of all those desiring the use of the same, those using the water for domestic purposes shall have the preference over those claiming for any other purpose, and those using the water for agricultural purposes shall have preference over those using the same for manufacturing purposes.

"Sec. 7. All persons and corporations shall have the right-of-way across public, private and corporate lands for the construction of ditches, canals and flumes for the purpose of conveying water for domestic purposes, for irrigation of agricultural lands, and for mining and manufacturing purposes, and for drainage, upon payment of just compensation.

"Sec. 8. The General Assembly shall provide by law that the Board of County Commissioners in their respective counties shall have power, when application is made to them by either party interested, to establish reasonable maximum rates to be charged for the use of water, whether furnished by individuals or corporations."

Declared Illegal. In the Colorado case, the pleadings showed the water company to be a carrier and distributor of water for irrigation and other purposes, with a canal upwards of sixty miles in length, and capable of supplying water to irrigate a large area of land. It had undisposed of a sufficient quantity of water to supply the wants of the relator, who was one of the land owners and consumers under the canal, and who could obtain water from no other source. He tendered the amount of the annual rental fixed by the company, and demanded the use of water for the current season, but the company demanded as a condition precedent to the granting of his request that he buy in advance "the right to receive and use water" from its canals and pay therefor \$10 per acre—just as the *San Diego Land and Town Company*, in the case decided by this court, demanded \$50 per acre at one time and \$100 per acre afterward, for a similar so-called "water right." The Supreme Court of Colorado held, as did this court in the case referred to, the demand in addition to the annual rates, for the so-called water right

illegal and void. In the course of his opinion, the justice delivering the opinion of the court said: "Our Constitution dedicates all unappropriated water in the natural streams of the State 'to the use of the people,' the ownership thereof being vested in the 'public.'"

Judge Ross further said: "Under the Constitution, as I understand it, the carrier is at least a quasi-public servant or agent. It is not in the attitude of a private individual contracting for the sale or use of his private property. It exists largely for the benefit of others, being engaged in the business of transporting for hire, water owned by the public, to the people owning the right to its use."

The Homeseekers' Association. One of the most notable occurrences of the past month was the public meeting of the Homeseekers' Association at the Wellington Hotel, in Chicago, on November 24. This association (the objects which are fully explained elsewhere in the issue) has been working for nearly two years and has been of material benefit to a vast number of the people in this city and in other places, but it is now entering upon a period when its usefulness will be multiplied many fold. About seventy-five prominent people were present at the meeting and it was decided to place in the rooms of the Association a permanent public exhibit of the agricultural, horticultural and mineral products of the various states. Definite promises of exhibits were made by the representatives of nine states and conditional promises by many more. The association is donating the necessary office space free

and it is expected that many of the exhibits will be ready for inspection by the middle of December. Two more public meetings will be held during the month of December, at one of which Capt J. M. Wells, World's Fair Commissioner from Idaho, Mrs. Alice Houghton, of the Board of Lady Managers of the World's Fair, and Dr. A. T. Ely, of Kennewick, Wash., will speak on the resources of the Northwest in general and the states of Idaho and Washington in particular. The second meeting will be devoted to Louisiana and the South, with prominent speakers. The association is making arrangements to hold regular meetings throughout the winter and also expects to begin immediately the publication of a series of pamphlets.

Important Matters. No apology is offered for devoting so much space in this department this month to the Wright Law and Judge Ross on Water Rights. No two decisions more vitally affecting irrigation interests have ever been rendered and it is now hoped that within a reasonable length of time the many perplexing problems surrounding this particular industry, which is almost entirely new to the mass of the American people, will be solved in accordance with a sense of justice, and that we will be able to move forward in the reclamation and settlement of our vast arid domain with the knowledge that both those who invest their money and those who invest their time and labor will be entitled to and receive a fair remuneration upon their investment.

THE HOMESEEKERS ASSOCIATION.

BY G. E. GIRLING.

THE aims and objects of The Homeseekers Association were fully set forth in the daily papers of Chicago and elsewhere at the time of its organization early in 1895, but for the benefit of those not conversant with the matter it will be briefly re stated :

The Homeseekers Association was organized by prominent clergymen of Chicago for the purpose of furnishing reliable and specific information regarding lands and locations, for settlers, colonists and invalids, to such as wished to avail themselves of this opportunity. The fundamental idea of the Association was broad, comprehensive and philanthropic. It reached over the boundaries of state and section and aimed at the advancement of the nation and the human race. It was conceived in no petty spirit of personal aggrandizement, but was nursed on the "milk of human kindness."

The need of such an association had been (and is now) demonstrated many times. The unfortunate individual who desired to better his condition, or was obliged for health's sake to change his residence, was surrounded on every side by importuning and in many cases unscrupulous land agents, each one of whom claimed to have "*the very best location on the face of the earth.*" With such a mass of contradictory statements before him it is not to be wondered at that the bewildered individual closed his eyes and chose at random, more often choosing wrong than right.

The ordinary home or healthseeker can not afford to spend the necessary time and money to visit and personally investigate the propositions laid before him and he mainly relies upon the word of others in making a selection that affect the whole future happiness and welfare of himself and family. Such a step should not be taken hurriedly or ill-advisedly, but sober, honest judgment should be brought to the task of deciding for each *individual* what would best meet his needs and tastes and requirements.

The Homeseekers Association not being a money making enterprise and having no interest in any particular state or section aims to lay before the inquirer simply the facts as they exist, leaving the individual to decide for himself where he shall locate, The great difficulty to be overcome was in *ascertaining the facts*, and the clergymen who organized the association, being representatives of all denominations both Catholic and Protestant, believed that their brother clergymen in the various part of the country would be better able to express an impartial unbiased opinion on the resources, advantages and possibilities of their particular locality than some who had financial interests at stake. But it must not be understood that clergymen alone will be depended upon to furnish this information.

THE GREAT MIDDLE CLASSES.

The Homeseekers Association aims to interest and educate the middle classes of America and Europe. It aims to implant deeply in their minds the desire for better conditions of average prosperity. The plan is to direct the agitation to the formation of branches of the National body in all parts of the country. The vast preponderance of wage-earning people live in the hope of something better. They are willing to give a hearing to a movement which deals with new institutions, and a hearing is all that The Homeseekers Association aims at.

The branches of The Homeseekers Association if they shall be extensively organized and then properly cultivated in the spirit suggested, will become the means of educating the masses to a proper appreciation of independence in country homes.

LITERATURE AND LECTURES.

The Homeseekers Association will work along the lines of the Chautauqua system, aiming to educate the people through a comprehensive system of literature and lectures. Members will pay the bare cost of providing the book and pamphlets.

A score of the best writers will be invited to co-operate in the preparation of this literature. The same literature will be used by all branch associations and one Board of Editors will suffice. This board will be sufficiently eminent to furnish an absolute guarantee as to the character of the statements put forth.

Such work as this must be above all suspicion of personal or local interest. It must be organized and carried out as a matter of the highest public spirit.

While The Homeseekers Association is not a money making enterprise it does aim to be self-supporting. Its income from memberships must equal its expenses for printing, postage and office assistance; the officers and directors giving their time free. The membership fee is one dollar and the annual dues one dollar after the first year, subject to change by the Board of Directors. The membership fee is pay-

able at the time the application is made and entitles the holder to any information at the disposal of the Association, and to any printed matter the Association may publish. A paid membership in the National body can be transferred without charge to any local branch upon the organization of the same, and the organization of branch associations will be authorized upon application of ten members to the National Association.

The series of public lectures contemplated will be explained hereafter.

During the past eighteen months the association has received many thousands of letters from all parts of the United States, Canada, Mexico, South America, European countries, Australia and India, and these along with a vast mass of statistics and information is being arranged and classified and will be placed at the disposal of members.

THE ART OF IRRIGATION.

CHAPTER XVII. THE AMOUNT OF WATER REQUIRED.

BY T. S. VAN DYKE.

THE amount of water needed for an acre of a given crop is commonly called the "duty of water." It is the most important branch of the whole subject and success or failure for the irrigator will depend greatly upon his comprehension of it. There are many who understand better than I those features of irrigation so far treated. The only advantage I have over them is that they are too lazy to write while I am not. But on the duty of water be careful how you criticise me. For many years it has been part of my business as promoter and builder of some very large irrigation works, where the water was very expensive on account of the high-line aqueducts necessary to reach high land, to prove to the land owners that they could pay what the water was worth. Proving to them what an inch of water under four inch pressure would accomplish was the only way to do it and the only way to prove that was to understand what I was talking about and be prepared to stand a rigid cross-examination on it at public

meetings or at the private button hole. Becoming interested in the subject it became a labor of love and I have probably measured more heads and subtracted the tail end waste, have watched more people irrigate and asked more questions, have examined more books of the water companies and lavished more beer and cigars on secretaries and ditch-tenders to get them to show me their water accounts with the different customers than any man living. I know that no one else in California has done so and outside of California full information on the subject is impossible. You cannot place the slightest reliance upon what the majority even of the best irrigators tell you about the duty of water. The most of them do not care and of the few that do hardly one secures or keeps any data and mere memory is of very little use.

ESTIMATED DUTY OF WATER.

The duty of water is commonly estimated by the miner's inch or the cubic

foot a second, but a much better measure is the acre foot or acre inch. This is the quantity needed to cover an acre a foot deep or an inch deep. It brings it to the basis of rain and is more easy to understand. Owing to loss from direct run-off. the coming of rain when not needed and the evaporation from the top soil of quantities too small to be of service it will on an average require two feet of rain as it commonly comes to equal in results one acre foot of water properly applied at the right times and with no more waste than is absolutely unavoidable to ensure wetting of the lower side of the tract.

The amount needed for any given crop is so dependent upon the nature of the soil, the climate, the rainfall and its time and manner of coming with the skill of the irrigator, the perfection to which he wishes to bring the crop, and so many other things that it is very difficult to lay down general rules. But the subject must be understood as far as possible by every one who wants to make much of a success of irrigation.

The duty of water is generally estimated by dividing the number of acres entitled to the water of a ditch by the number of cubic feet a second or inches which the ditch is supposed to carry, alleged to contain or supposed to be capable of carrying if in good condition. This debits the duty of water with all waste and all errors about the quantity flowing. Both of these are very great, especially the waste where the whole capacity of the ditch is not yet called for by the rate of settlement and the loss of water consequently immaterial. You might as well try to find the duty of meat by dividing the number of pounds taken in the kitchen door of a five dollar hotel by the number of guests on the register. When this method is extended to all the ditches in the country, and the area supposed to be under them divided by the water supposed to be in them all, we get the charming figure of about fifty-four acres to a cubic foot a second. This will cover an acre about fourteen feet deep. While our esteemed Department of Agriculture no doubt does the best it can with the data available the monstrous absurdity of the conclusion should be so patent as to forbid its publication. It can only mislead people into thinking irrigation out of the question in thousands of places where it can be used

to great advantage. Nothing could discourage the investment of capital in irrigation works like the belief that any such quantity of water is necessary and no one would want to irrigate if he had to put on fourteen acre feet even in a whole year. Nothing but coarse sand or gravel could take any such quantity without making a swamp of the place, while ground fine enough to be worth cultivating at all never needs over one-third of that amount even in the hottest countries where the rainfall is practically nothing. Waste is sometimes justifiable where water is plenty because it may save labor. It may pay to turn a large stream into furrows so as to force the water through quickly while you do something else instead of standing there to coax it. But this is waste and should not be charged against the duty of water. The future prosperity of the west is bound up in the development of water and the farther it can be proved to go the easier it will be to get the needed capital.

The uncertainty as to the duty of water is farther increased by the common way of counting *by the rate* at which water is used during a certain period called the "irrigating season" and not by the quantity actually put upon the ground during the year. This irrigating season varies so with the locality, the climate, rainfall and products as to increase the uncertainty.

WATER ON TEN ACRES.

Here is the water amount of a ten acre tract in miscellaneous stuff in one of the most prosperous settlements of Southern California. It is taken from the books of the company and shows exactly the number of twenty-four hour inches put on the tract that year. The water right was one inch to ten acres.

May...	thirty inches...	twenty-four hour's run.
June...	forty-five inches...	sixteen hour's run.
July...	thirty inches...	twenty-four hour's run.
August.....	sixty-inches...	twelve hour's run.
Sept....	forty-five inches....	sixteen hour's run.
October.....	sixty-inches....	twelve hour's run.

You see that in six months the owner used one hundred and eighty twenty-four hour inches. But under the water-right there was due the tract the equivalent of one-inch for three hundred and sixty-five days. This would be three hundred and sixty-five twenty-four hour inches, where as he used only one hundred and eighty. What then became of the other one hundred and eighty-five twenty-four hour inches?

If the land-owner could have got them during the six months of summer he would have either wasted them or have extended his acreage. Or if he had the place in alfalfa he might have used them all to advantage on the ten acres. But very few companies either public or private could run on such a principle without too great an expense for the water and the size of the aqueducts for its delivery or too great a clash of interest among the irrigators. For an inch of water means the equivalent of an inch for a year taken in heads according to rules for the convenience of all consumers and one of the first of these generally is that one cannot exceed thirty twenty-four inches a month. During the other six months he could have had the other one hundred and eighty-five twenty-four-hour inches. Had he used them he could have extended his acreage or used less water on the piece he actually irrigated as shown in the chapter on winter irrigation. But he preferred to take his chances on the clouds doing their duty and let them go to the sea unused—a clear waste of public wealth. If the clouds failed to do their duty then he would need more than thirty inches a month for the summer; but he not only could not get any more, but he might under the rules have to take less; for no ditch can be successfully managed even by the landowner's without making all take shortage sometimes.

MORE ABOUT DUTY OF WATER.

Be careful now and follow me closely for this subject has puzzled many a head.

During the six months the water was used on this ten acre tract it was used at the rate of three hundred and sixty-five twenty-four hour inches for the year. But the actual business was done by one hundred and eighty twenty-four hour inches. But as during the six months of actual use it was applied at the rate of an inch to ten acres it is called an inch to ten. The absurdity of this is more apparent by supposing it had been only once, say thirty inches in July. Because used at the rate of an inch it is still called an inch to ten, whereas the quantity actually put upon the ground is but one-sixth of what it was before. According to this in a country needing so little irrigation that once a year would suffice the duty of water would be about the same as in one needing it all the time.

But how are we to get at the duty any other way? Well, at present it is not easy. It is certain that the effectiveness of any water system, as a system, can be tested only by what it will do during that period of the year when most water is needed and vegetation will suffer most if not quickly and fully supplied. That is the way this method of computation arose and remains in fashion. If a stream will furnish a thousand feet a second during the winter when it is not needed, or if people think it is not needed, which for this purpose is the same thing, but will furnish only one hundred feet during the three summer months when the water is most needed and the full capacity of the stream is in demand every day, it is clear that the power of that stream as an irrigating resource is measured almost entirely by what it will furnish during that time.

On the other hand it is just as certain that had the owner of the ten acre tract above mentioned put upon the ground the one hundred and eighty-five twenty-four hour inches that went to the sea the other one hundred and eighty would have done more duty than they did. The one hundred and eighty-five would have covered the tract about nine inches deep, which would in effect have been equal to about eighteen inches of rain as it generally comes here in winter. Added to the regular rainfall, which at that place is about twenty inches, it would have put the ground in such condition that almost anything but oranges, lemons, berries and a few such things would give a good yield without any irrigation in summer. When water becomes valuable enough to make people store it in the ground if they cannot afford to store it above, the duty of water will be estimated by the depth of water put upon the tract during the year. Until then it will be estimated by the rate for the irrigating season because the great majority of the canals of the country depend upon the flow of streams that are lower during that time.

If "the season" were everywhere the same we might compute in this way. But as it varies continually with locality and products you will never unravel the tangle of opinions on the duty of water until you understand the following figures:

A miner's inch under four-inch pressure will cover about fourteen and a quarter

acres one foot deep in a year. Now if we call "the irrigating season" two hundred days, then the number of acres to an inch of water will by this mode of counting be two hundred three hundred and sixty-fifths of fourteen and a quarter ($\frac{306}{14\frac{1}{4}}$ of 14 $\frac{1}{4}$). This will be about eight. But counting by the year the number of acres watered to the same depth would be about fourteen and a quarter. So they will call an acre foot if used in two hundred days an inch to eight acres, but if used all the year an inch to fourteen and a quarter. Two acre feet would then be an inch to four acres by the season, but estimating the other way they would be three hundred and sixty-five-two hundredths to four acres ($\frac{365}{200}$ of 4) which equal about seven. And in the same manner four acre feet would be an inch to two acres by the season and about three and a half by the year.

The only reliable way to find the amount of water used is to take a tract of known area and watch it while being irrigated so as to get the percentage wasted at the lower end. This will vary greatly, some wasting even more than half the head while others will have the lower end of the tract thoroughly wet without wasting one per cent. As this waste can be found only by guess considerable care must be used in comparing it with the head at the upper end. As the owner knows little more about what he is putting on than the most intelligent Hottentot knows about the rainfall that produces his banana crop, you had better go to the office of the company and ask to see the water account of that tract. If you satisfy the officers that you are seeking information for a proper purpose and will not use it in any other way, you will seldom be refused a full inspection of the books. Sometimes it may cost you the drinks and some cultivation of the secretary or ditch-tender until he finds you are a harmless person.

Get the number of twenty-four hour inches delivered to that tract during the

irrigating season and also during the year. Deducting the unnecessary waste you can then reach the duty of water by both methods. As a rule you will find the duty of water much greater than the owner himself would give it to you. But you will find that some people, with exactly the same amount of land, same soil, crops, and all conditions, have ordered and paid for twice as much as their neighbors. By watching these tracts you will find this difference due mainly to waste. But in some it is due to using water more often and letting it run longer. There are individual differences due often to the whim of the irrigator and often to the desire to experiment that cast much uncertainty on the conclusions drawn even from the best data.

For alfalfa it is certainly safe to err in using too much water than too little. So with oranges and lemons, melons and many other things. There is little danger of using too much water for corn, but you can easily use so much as to make the yield of grain lighter instead of heavier. Grapes to be used for wine, olives and peaches and other fruits to be shipped some distance to market will not be apt to suffer if the error is on the side of too little water. It would almost take a treatise on agriculture and horticulture to go through the list of all products in this way, but the difference should be kept in mind.

The waste above referred to means direct waste. Indirect waste is a great item that reduces the duty of water. The commonest form of this is using water instead of the cultivator, already sufficiently explained. It is a great absurdity to charge against the duty of water the amount poured on by one who will persist in irrigating in the old Indian style. Yet under many ditches fully one-half the water is still wasted in that way. And the resources of that section are depreciated by charging it against the duty of water.



FOURTH ANNUAL SESSION OF THE KANSAS IRRIGATION CONGRESS.

BY L. BALDWIN.

THIS organization convened at Great Bend, Kansas, according to previous announcement, and held one of the most important meetings in the history of the irrigation movement. The attendance and interest increased from the reading of the call on Thursday morning until late Saturday evening, three sessions each day. We had material for another day's discussion, but as Sunday was approaching we had to adjourn. The papers read and the subjects discussed indicated a high degree of intelligence upon the great subject of the reclamation of the semi-arid lands of Kansas. Good critics say our program contained more attractive and pertinent matter than was ever before presented. The three members of the Kansas Irrigation Board were present and explained the progress they were making in solving the problems contemplated by the act of the Legislature; the State University furnished Chancellor F. H. Snow, who lectured on the method of getting rid of grasshoppers and other insects that damage irrigated crops. The hints he gave to that end are valuable to our farmers and gardeners; Prof. Haworth lectured upon the artesian waters of Kansas, and located the places where we might find flowing wells and where it is useless to explore; President Fairchild and Prof. O. P. Hood, from the State Agricultural College, discussed their subjects in a very instructive way.

Two experts were with us from the United States Geological Survey—Willard Johnson and W. G. Russell, who lectured upon the underground and surface waters of western Kansas. The secretary of the State Board of Agriculture was here to tell us about "*some other things*." Hon. John E. Frost, land commissioner of the Santa Fé road, read a paper on the "Progress of Irrigation in the Arkansas Valley." W. C. Edwards read a paper on "A Little Farm Well Tilled." Judge J. S. Emery was in his element while exhorting the people living upon the great plains to "stay right where they are," as they were

sure to have plenty of neighbors in the near future. He quoted Hon. Tom Reed as saying that "beyond the Mississippi river is the country where will be found the wealth and greatness of the days to come." He quoted an editorial from the Chicago Tribune which read: "Kansas can boast of a greater diffusion of popular education and a smaller percent. of illiteracy and crime than any other community on the face of the globe, and for all that pertains to a strong and vigorous state the history of civil society furnishes no parallel."

George Munger, of Eureka, Kansas, told us about his big artificial lake of ninety acres, which he had created by damming a large drain, and which he was using to irrigate an orchard of 600 acres of trees. He raised cabbage to such an extent that he stopped the importation of it into his county. The limits of this magazine will not permit me to keep on, as I have started out, to review all the articles and papers by all the gentlemen on the program, so I will refer them to my official report, and also to the Kansas Farmer, in which the papers read will appear from time to time. The following resolutions were adopted:

Resolved, First, That we appreciate the work of the State Irrigation Board and know it has done all and only just such work as it could do under the provisions of the law creating it, and now think its power or the powers of some other authority or commission should be greatly increased by the next legislature so as to enable it to meet all the wants and needs of our people in carrying forward the great work of reclaiming our semi-arid lands.

Resolved, Second, That Kansas most earnestly asks the General Government to create an *Irrigation and Forestry Commission* for the examination, utilization and conservation of the water supplies and forest growths of arid and semi arid America.

Resolved, Third, That we fully appreciate the work done in Kansas by the

United States Geological Survey under the immediate direction of F. H. Newell in the gauging and measuring of the river waters of this State, and we urge that this work be carried forward to its full and final completion at as early a date as may be practical.

Resolved, Fourth, That we extend our most hearty thanks to the citizens of Great Bend for the many courtesies we have received at their hands, and also to those gentlemen who have addressed this convention and also to the *press* for giving us a hearing before the general public.

Signed:

DR. BOHRER,
W. ANDERSON,
J. S. EMERY,
M. B. TOMBLIN,
W. C. EDWARDS,
D. M. FROST,

Committee on Resolutions.

The following gentlemen were chosen as officers and executive committee for the next year:

President—I. L. Diesem, Garden City, Kan.

Secretary—L. Baldwin, Great Bend, Kan.

Treasurer—Geo. M. Munger, Eureka, Kan.

EXECUTIVE COMMITTEE.

Hon. John E. Frost, *Chairman*, Topeka, Kansas.

E. R. Moses, Great Bend, Kansas.

Judge W. B. Sutton, Russell, Kansas.

Prof. E. Haworth, Lawrence, Kansas.

D. M. Frost, Garden City, Kansas.

I. L. Diesem (*ex-officio*).

L. Baldwin (*ex-officio*).

Geo. M. Munger (*ex-officio*).

The Chancellor of the State University of Kansas having extended a hearty invitation to the Irrigation Congress to meet in Lawrence next year it was accepted by a rising vote, the time to be determined by the executive committee. The Congress then adjourned.

L. BALDWIN, Secretary.

Great Bend, Kansas.

October, 1896.

SOME RECENT COURT DECISIONS.

ADVERSE POSSESSION—ABANDONMENT.

BY CLESSON S. KINNEY, OF THE SALT LAKE CITY BAR.

IN the case of *Smith et al vs. Hope Mining Company*, the Supreme Court of Montana held that the defendant's use was not adverse to plaintiffs' right, where in a compromise settlement as to water rights between two mining companies it was agreed that the defendant had prior rights to fifteen inches of water, and that it should take the same through plaintiffs' ditch, and that it should also have the use of a further amount of water which was over and above the water necessary for plaintiffs' mill. The evidence disclosed the fact that plaintiffs closed their mill in 1883, and from that time to 1893 used no water; defendant, as it might under the contract, during this period, using all the water conveyed into the ditch. Also the defendant gave no notice by word or deed that it claimed otherwise than under the contract.

And also in the same case, when plaintiffs' mill was shut down, a man was employed to drain all the pipes and oil the machinery, and during the whole period of non-use some one had charge of the property, a watchman being on the premises and caring for them most of the time. The water was not used simply because the machinery of the mill was not in motion. The court held that there was no intention to abandon the mill, and hence none to abandon the appurtenant water right.

CORPORATIONS.

In the case of the *Consolidated Canal Company vs. Peters*, decided by the Supreme Court of Arizona, 46 Pac. Rep., 74, it was held that a contract between a canal company and the shareholders in an unin-

corporated joint stock association, whereby the former party of the first part agrees to furnish water to the "respective parties" of the second part, and the latter agrees to rent their "respective" shares in the association to said first party in a several contract, and either of the second parties may maintain suit for damages occurring to him thereunder, without joining the others.

Also in the same case, where the Utah Canal Company rented their shares to defendant, a corporation, the latter agreeing to deliver water to said parties "at and on the basis rate of not less than three shares for the necessities of a quarter section, said water being in the river. * * * It being understood that, in case of low water, defendant is to deliver that amount of water that the Utah canal could or would deliver if they were in full control." A complaint by one of the shareholders who entered into said contract alleged that defendant refused to deliver water in sufficient quantities to irrigate the crops when there was water flowing in the river sufficient for such purpose, and, at periods of low water, had refused to deliver to plaintiff the amount of water that the Utah Canal Company would or could deliver if it were in control. However, the complaint did not allege that plaintiff ever requested defendant to deliver water to him, and did not state how much was necessary nor the the quantity actually delivered, and there was no averment as to the amount that could or would have been furnished by the Utah Canal Company. The court held that the complaint did not state a cause of action.



AFTER THE CONGRESS.

THE natural resources of the wonderful State of California and its unrivalled climate have been written about innumerable times, nevertheless, it will not be out of place to refer to them again at this time, as the delegates and visitors at the Fifth National Irrigation Congress at Phoenix, Arizona, December 15 to 17, will have an opportunity of personally inspecting some of the more renowned points, especially in southern California. After the close of the congress excursions will be made to Los Angeles, Riverside, Redlands and several other towns for the purpose of showing what can be accomplished with a combination of California climate, fertile soil and water.

The model colonies will undoubtedly attract the most attention from those who are in any way interested in the movement of population from cities to country homes and its relation to irrigation, and also its relation to the welfare of the nation at large. The community settlements in California have been a success, though possibly not as great a success as their founders hoped for, but they clearly demonstrate that the associative principle will underlie all future development in reclaiming the arid lands of the West.

Colonization and irrigation go hand in hand. Nearly, or indeed, every effort to establish a dry-land colony in California has ended in failure. Probably the earliest notable experiment in the colony line was in 1857, at the time the first grape craze swept over the state. Some German mechanics in San Francisco were infected with the vineyard fever, and not one of them could bear the expense or had the necessary experience to plant and bring to maturity a twenty-acre vineyard. After considerable discussion they decided upon what was then an original plan, and which may be said to be the pattern for modern colonies. One of their members was delegated to visit southern California, investigate and report. A tract of 1,200 acres

was contracted for at about \$1.50 an acre, a superintendent chosen, and under his directions the tract was laid out, a town site surveyed and the whole area planted with trees and vines in such manner that when the colonists took possession of their property, each twenty acres should have the same area of the different varieties of fruit. The members of the colony remained at work in San Francisco until the vines began to bear fruit, and then moved on their little farms, which were now self-sustaining.

Such in brief is the history of the Anaheim colony, which will probably be one of the points visited by the irrigation congress delegates.

The success of Anaheim was followed by the founding of other colonies, some of which have become known the world over.

The casual visitor or tourist who is unacquainted with the miracles irrigation has wrought will be inclined to think that he is being given a modern version of Andersen's fairy tales instead of every day truth. It may stretch his belief in the veracity of the narrator beyond the limit when he is told that this superb state produces annually 70,000,000 pounds of raisins, 30,000,000 pounds of prunes, 8,000 carloads of oranges, 20,000,000 gallons of wine, 26,000,000 pounds of beet sugar, not to mention the other fruit, vegetable and cereal crops. And all of these products dependent, in a large measure, upon artificial watering to bring them to maturity.

But if the visitor is not interested in such practical matters he will be amply repaid for the trip by the sights and scenes along the way, or he can join one of the excursions which will visit the Grand Cañon of the Colorado, where he will find some of the grandest and most imposing scenery in the world.

For further particulars regarding the congress and the excursions to follow it, see the announcements elsewhere in this issue.



THE DIVERSIFIED FARM

In diversified farming by irrigation lies the salvation of agriculture

The Age wants to brighten the pages of its Diversified Farm department and with this purpose in view it requests its readers everywhere to send in photographs and pictures of fields, orchards and farm homes; prize-taking horses, cattle, sheep or hogs. Also sketches or plans for convenient and commodious barns, hen houses, corncribs, etc. Sketches of labor-saving devices, such as ditch cleaners and watering troughs. A good illustration of a windmill irrigation plant is always interesting. Will you help us improve the appearance of The Age?

HOW BARNYARD MANURE IMPROVES THE SOIL.

BY F. C. BARKER, OF NEW MEXICO.

A LITTLE knowledge is a dangerous thing. This maxim is particularly to be borne in mind when one comes to apply chemistry to the science of farming. A very good instance of this occurs in the study of the land in the Rio Grande valley. This land is yearly irrigated by the waters of the Rio Grande river, which contain an abundance of potash, phosphates and nitrogen—indeed far more of these fertilizers than are removed by the yearly crops. Let us take, as an example, the nitrogen, the most essential item in plant growth. The land receives an average of at least 24 inches of water from the river every year, and the sediment of this water leaves 107 pounds of nitrogen on each acre. An acre of wheat does not remove more than 45 pounds of this nitrogen. It therefore follows that if the land is irrigated and cropped with wheat year after year, as is often the case, the land will in time be so full of nitrogen that there will be no deficiency of this fertilizing item whatever be the crop that the farmer wishes to raise. As for potash and phosphates the excess will be still greater. But this theory does not work out in practice. Actual experience has shown that this land will not raise cabbage, or other garden truck, without the application of barnyard manure, and that even the wheat crop will be nearly doubled by putting on say 10 tons of this manure every three or four years. Now it is evidently not the nitrogen in the manure that thus benefits the crop, for ten tons of manure only contains about as much nitrogen as the 24 inches of water; moreover, there is already an excess of nitrogen in the soil.

HOW NITROGEN IS UTILIZED.

The explanation is to be found in the fact that the nitrogen deposited by the water is in an inert state, and not capable of being utilized by plant life. Before nitrogen can be absorbed by plants it must go through a ferment. The most modern chemical researches have shown that this ferment is caused by minute living organisms or bacteria of a somewhat similar nature to those which cause the fermentation of wine, cream, etc. These organisms are found in abundance in humus (decayed vegetable matter) and barnyard manure. Now it is well known that our western land in the arid districts are particularly deficient in humus and unless these fermenting organisms are applied to the land by means of barnyard manure the nitrogen already contained in the soil is apt to remain in an inert state, unfit for plant food. The experience of farmers, not only here, but in many parts of the world, is that barnyard manure gives results far in excess of what might be expected from its actual fertilizing contents. The reason of this is that the fermenting organisms contained in the manure not only render the nitrogen in the manure fit for plant food, but they ferment and convert into plant food the inert nitrogen which already existed in the soil.

There is, of course, an additional reason why barnyard manure is beneficial, and that is that it improves the mechanical condition of the soil and the humus enables it to better hold moisture.

It therefore follows that however rich land may be considered to be if it is deficient in humus a light dressing of barnyard manure every three or four years will probably be found to yield beneficial results far in excess of the cost of supplying the manure.

PLANT FOOD RESERVOIRS.

BY E. MIALl SKEATS IN THE PECOS ARGUS.

“**W**HAT an expanse of useless land,” if often the remark and still oftener the thought of people traversing our foot hills. As well might they say “what an expanse of useless water” when they view our huge storage reservoirs.

The foot hills are reservoirs of soil for our valley lands. Immense amounts of plant food are stored there and are being manufactured into available forms every year, and as they are manufactured are distributed over the valley.

Visit the hill now after the heavy rains we have just experienced. Besides the conspicuous Cacti, Yucca, Euphorbia, you will be surprised at the number of small—some exceedingly small—annual and perennial plants covering the rocky ground. Choose almost any of these and try and pull it up by the roots. It resists. Lift up the flat stone adjoining and you find the roots underneath ramifying sometimes for several feet in as fine a vegetable mould as any gardener would wish to see.

But see! There is actually an earth-worm in it, right on top of the hill. And how wet the soil is, though down in the valley at the same depth it has become fairly dry.

You have surprised some of nature’s agents in full work in a veritable chemical laboratory by lifting that stone. The radiated heat from the flat stone fully exposed above to the sun’s rays has warmed up the damp thin stratum of vegetable soil, and given extreme impetus to the root play of the plants in the crevices, the evaporation from whose leaves is about the only exit for the remaining moisture in the soil.

But this warmth has so enlivened myriads of microbes which are rejoicing in the feast of dead vegetable matter in the soil, and their growth results in further decomposition of the dead rootlets, and the evolution of carbonic acid and other gases.

These gases, imprisoned under the slab, attack the stone itself, till by very imperceptible degrees, it crumbles away and adds its valuable ingredients to the vegetable soil. Nitrates in abundance are formed in this damp, warm compound. Phosphoric acid, rich in the stone, is made

available, or partly so, for plant use, and so are the lime and magnesia.

The earth worm does his share; he devours the dead rootlets and leaves and swallows small particles of stone not decomposed. He uses the stones as masticators and wears them down till his strong digestive fluids dissolve much of them with the vegetable matter and what he does not want for his own economy he leaves for future generations of plants.

By the time the next rains come there is a store of the richest plant foods in soluble form under this stone. The first floods wash this out and carry it to the nearest gully. It flows down this onto the plains, where it is dispersed, and much is caught and held by the heavier, more clayey soil. In the spring, with the strong west winds, much of this is still further distributed over the valley and farms.

Who can say that the foot hills are of no use to us?

FOREIGN MARKETS.

In his annual report Secretary Morton says during the fiscal year just ended the exported products of American farms aggregated \$570,000,000, an increase of \$17,000,000 over the preceding year. In spite of this there was a falling off in the percentage of agricultural products exported to the total exports, but this was due to the unprecedented sale abroad of American manufactured goods. The principal market for American products is found in the United Kingdom of Great Britain and her colonies. These English-speaking people bought 58 per cent of all exports from the United States in the fiscal year 1896. Together with Germany, France, Holland, and Belgium, they purchased 81.9 per cent of our entire output, leaving 18.1 per cent for the rest of the world.

The total consumption of meat in Great Britain for the year was 1,100,000 tons, 75 per cent of which was produced at home, the remaining 25 per cent being imported. Of live meat arrived in the United Kingdom during the first six months of 1896 the United States supplied 75.10 per cent of the cattle and 45.26 per cent of the sheep. The Glasgow market is especially recommended to American shippers, as in that city cattle

from the United States compete with the very highest quality of British animals.

American packers, the Secretary says, are not participating in the profits of the growth in consumption of swine flesh and hog products in Great Britain as much as they ought to, because they do not cure meats to suit the British demand. On the other hand, Danish and Canadian packers are increasing their shipments every year. American bacon averages about two cents per pound below continental and Irish bacon, and about three cents below English.

The shipment of American horses to England is steadily increasing. In 1893 Great Britain took 13,737 American horses, nearly 23,000 in 1894, and 34,000 in 1895, but during the first nine months of 1896 more American horses were shipped into England than in any previous twelve months.

Kaffir Corn.—J. H. Shaeffer called last Saturday at our office and gave us an account of his crop of Kaffir corn, says the Lake Charles (La.) American. He planted the corn on new ground that had never been fertilized, and put no fertilizer on the crop. He says the yield was five wagon loads of heads per acre, that would shell out fifty bushels of clean corn. Since cutting the first crop, the corn has continued to grow and has put forth new heads on which the grain is now forming. Mr. Shaeffer says the Kaffir corn will continue to grow until frost. In view of the above facts, given by one of the most careful farmers of this region, we claim that Kaffir corn is the best food crop to grow in this region.

The points in its favor are, first, that it grows luxuriantly and yields well on new and unfertilized ground; second, that it will stand a drought better than almost any other crop—equaling sugar cane and sorghum in this respect; third, that it will give a large yield of grain—amounting from forty to sixty bushels per acre, the first crop, and will then produce a second crop of grain, and an enormous yield of fodder for a second crop; fourth, that the grain is excellent, fully equaling in value the common corn for stock feed, and producing, when ground, meal or flour much superior to the common corn. It is said that flour made from Kaffir corn is fully

equal to buckwheat flour for griddle cakes, and makes a delicious bread when baked.

The drawbacks are few, the principal one being that birds are very fond of it; and when only small patches are planted they destroy it badly. When this corn is planted largely, as it should be by our farmers, this objection will cease.

General Purposes.—When searching for an all-purpose animal, whether it be cow, sheep or hen, just remember that no animal can use its food twice. If a cow converts her food into milk she cannot convert the same food into beef. If a sheep converts his food into wool he cannot convert the same into mutton. If a duck converts its food into feathers, it cannot convert the same food into eggs; hence, if you pick your ducks and geese regularly, you need not expect many eggs from them. Of course every animal gets a living from what it eats—enough to sustain its life and strength—before it turns off any surplus for you. But if it has been bred to turn the surplus into beef, you will lose money trying to persuade it to yield butter instead. Decide what kind of a surplus you want, and get the breed which converts its food into that product, and don't expect one mill to turn out graham flour and horseshoe nails.—*Texas Stock and Farm Journal.*

In Egypt at least 50,000 pumps and water-wheels are in use. The power used for propelling these consists of wind and oxen. About 200,000 oxen are used for pumping water from wells which are shallow and and dug after a very crude manner. The water thus secured is used for irrigating rice and cotton. The average cost of well and pump is about \$150 and the cash rental of land ranges from \$2 to \$5 an acre. This method though crude, enables the farmers of Egypt to secure good returns.

Massachusetts has the largest cider mills in the world, using 8,000 bushels of apples per day and producing 32,000 gallons of refined cider daily. Our readers who are not in the apple belt will readily see the profit in the fruit for the growers get from six to nine cents per bushel. This factory exports over one and a quarter million of gallons to England annually.

The Irrigation Farmer.—Irrigated farms have a tendency to induce their owners to cultivate crops that will pay the largest profits, and the irrigation farmer is in a vast majority of cases, a man of high intelligence who studies to make his land as profitable as possible. He has broken loose from the traditions of his forefathers because he is surrounded by different conditions.

Save the Winter Rains and Snows.

—The winter rains and snows are a constant source of waste of water that might be held in natural basins or easily constructed reservoirs for use in irrigating during the coming season. There is no better time than the present for irrigators to investigate the subject of securing an independent water supply.

If the soil is of a character to admit of constructing catchment reservoirs every available location should be used. In the foothills of the mountain valleys are basements covering from one to fifty acres where with a little work a large body of winter water may be held. Small channels made with an ordinary plow will be sufficient to lead the water into the reservoirs. In this manner the rains that would otherwise swell the mountain streams and run away causing frequent floods and damage can be utilized to furnish moisture for the next season.

The Government Seedshop.—By order of congress \$130,000 worth of seeds will be distributed in 1897. This equals \$288.89 for each representative, senator and delegate in congress, or enough to allow 30,000 packets of seeds to each member, including field seeds in quart packets. In buying this seed bids were invited from all firms, and to insure seed adapted to the various sections the contracts were awarded to a responsible firm in each section—eastern, south Atlantic, middle western, northwestern and southwestern states, contracts for the Pacific states not yet being awarded.

Selling to Consumers.—A writer in Detroit Tribune says that when in England last winter, he noticed the farmers were trying to cut the middleman and deal directly with the consumer. One method was to advertise freely in the newspapers.

An advertisement read thus: "Provisions from a Suffolk farm—Twelve new laid eggs, one pound of butter (silver medal), jar of cream, two plump fowls—or one fowl and a loin of pork, one pound of sausages, jar of potted meat; carriage paid, London or suburbs, cash on delivery, 10s. 9d. M. Suffolk." Another was as follows: "Welsh mutton, direct from the farmer, 8½d. for the whole, sheep averaging 40 pounds, delivered free to any address in London. Send postal order 30s., balance, if any, returned in stamps—Reference. etc." Why cannot the idea be carried out in this country? Possibly it is in some places, and if any of our readers know about it we shall be glad to hear with what success it is attended.

Carrying Stock.—A stock run from Pueblo to Kansas City, a distance of 635 miles, was made in twenty-one hours and twenty-seven minutes, on the Atchison recently. No other line has as yet come within that limit of speed between these points, in hauling a stock train of similar tonnage,—that is a speed of thirty miles an hour including all stops and delays in transit. Such time is possible because there is a system and discipline built up on the Atchison that is as near perfect as may be. The humblest employee as well as the highest official, seems to be at all times enlivened with a sense of importance in maintaining a routine that carries with it safety and dispatch.

Some of the soils in the irrigated districts which were formerly hard and difficult to work have changed and become mellow. The water has undoubtedly caused a chemical and mechanical decomposition of the components of the soil which has caused it to continually improve. Even certain kinds of hard-pan have been known to dissolve when irrigated.

A farmer sent a dollar for a lightning potato bug killer which he saw advertised in a paper and received by return mail two blocks of wood with directions printed as follows: "Take this block No. 1 in the right hand, place the bug on Block No. 2 and press them together. Remove the bug and proceed as before."

A patch of sweet corn makes one of the best crops to grow to commence feeding hogs intended for fall market.

PRICE, 10 CENTS.

DECEMBER, 1896

\$1.00 A YEAR.

VOL. X.

No. 6.

WILL CAPITAL BE TREATED FAIRLY IN IDAHO.

112 DEARBORN ST., - CHICAGO.

Spiral Riveted Water Pipe.

Irrigation, hydraulic mining, water power, sewer construction, etc.
Connections and Fittings to Suit Service Required.
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IRRIGATION MADE CHEAP.

THE "NEW ERA" GRADER AND DITCHER.

One mile of this style of ditch, 24 feet wide at top, 18 feet wide at bottom and 5 feet deep can be built by 3 Men and 12 Horses from 15 to 20 Days; 2½ miles of laterals per day 8 feet wide and 15 inches deep; any size between at the rate of 1,000 to 1,500 cubic yards per day.

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Mention the IRRIGATION AGE.

The Pecos Valley of New Mexico.

The part of the Pecos Valley which The Pecos Irrigation and Improvement Company has undertaken to reclaim by irrigation, is situated in southeastern New Mexico, extending into northwestern Texas, and comprises a large area of as highly productive agricultural and horticultural land as can be found on the American continent. At intervals along the Pecos River, for a distance of 165 miles, have been constructed dams, reservoirs and canals, furnishing an abundant and unfailing supply of water for 400,000 acres, over one-half of which area is already covered by the canals. The reservoirs have a total capacity of 6,300,000,000 cubic feet of water; the canals, with the main and sublaterals, have a total length of 1,500 miles. About 75,000 acres are already in the hands of settlers, of which over 25,000 acres are in actual cultivation, 2,500 acres being in orchards and vineyards. To further develop this region, a standard gauge railway, 164 miles long, has been built through the entire length of the Valley. Towns and villages have been started, of which Eddy and Roswell are the largest, the former having about 2,500, and the latter about 2,000 inhabitants. Hagerman, Otis, Florence, Francis and Malaga are also growing villages. This work was undertaken a little over seven years ago, and has already cost over four millions of dollars. The Pecos Valley now ranks as the largest irrigation enterprise in America, and one of the largest in the world.

A THREE-YEAR-OLD APPLE TREE IN THE PECOS VALLEY.

Soil, Climate and Productions.

The soil of the Pecos Valley is, in the main, a sandy loam, and is of remarkable depth and richness. The climate is warm and sunny, practically winterless, with long growing seasons, and likewise possesses wonderful health-giving and health-restoring properties, especially for pulmonary and many other chronic diseases. This soil and climate, with the abundant water supply, unite to produce bountiful crops of all the grains, grasses, berries, vegetables and fruits of the temperate zone. Such forage crops as alfalfa, sorghum, Indian and Egyptian corn grow most luxuriantly, making the feeding of cattle, sheep and hogs a most profitable industry. The sugar beet attains a perfection not reached elsewhere in the

United States, if in the world. A beet sugar factory, with a daily capacity of 225 tons of beets, is now being built at Eddy, and will be in operation November 1, 1896. To supply this factory the farmers of the Valley are now putting in fully 2,500 acres of beets, for which the sugar factory has contracted to pay \$4 per ton delivered at any station on the Pecos Valley Railway, the company paying the freight to the factory. At this price, and with the large yield per acre in the Pecos Valley, the farmer should clear all the way from \$35 to \$75 per acre from his crop of beets.

In the raising of fruits the Pecos Valley will take its place among the most highly favored sections of our land. All the standard fruits of the temperate zone are successfully raised, while several of these attain a perfection rarely equaled and nowhere surpassed. At the head stand the apple and pear, closely followed by the peach, grape, nectarine, apricot, plum, prune and quince. All the small fruits grow in abundance. The fruits of the Pecos Valley are without blemish, superb in form and coloring, and of unequalled flavor. In a few years they will be found in all the great markets of the country, commanding topmost prices because of their beauty and perfection.

Social and Educational.

The Pecos Valley is being settled in the main by progressive and intelligent people, the majority being Americans, mainly from the Central West. As a result, schools and churches are found in every town and village in the Valley.

The Pecos Valley, while attracting the general farmer and fruit-grower, holds especial attractions for those whose health requires an outdoor life in the dry, elevated region of the Rocky Mountain plateau; and these will there find not only the health they seek, but profitable occupation as well. Not only does this life appeal to the health seeker, but also to the thousands all over our land, and especially in our large cities, who wish to exchange the life of grind and drudgery and narrowing industrial conditions, for one of independence and a larger hope for the future.

For prices of land, and terms, with copies of illustrated publications, address The Pecos Irrigation & Improvement Co., Eddy, New Mexico.

(ADVERTISING SUPPLEMENT.)

CAYDOUR CANAL, IN ITALY (Irrigation)

THE IRRIGATION AGE.

VOL. X.

CHICAGO, DECEMBER, 1896.

NO. 6.

THE PROGRESS OF WESTERN AMERICA.

Again the Homeseekers Association. The work of The Homeseekers Association has progressed rapidly during the past month and its membership is increasing to thousands. It seems to have struck a popular chord and everywhere meets with great encouragement. The large percentage of population which is considering a change of location in the expectation of finding better conditions is almost inconceivable to the average mind. As an illustration of this it may be cited that the simple announcement of a meeting invariably caused the headquarters of the Association to be filled full to overflowing with those seeking information. The most prominent feature of this month's work was the public meetings both in Chicago and Minneapolis. At the meetings in Chicago were delivered lectures on the resources of some of the Western and Southern States. The Minneapolis meeting was called at the instance of the Board of Trade and Mr. Girling was invited to address it on the Association and its work. The direct result of this meeting was the organization of a branch association.

On Sunday, January 3, a special Homeseekers service will be held in the Militant church and the pastor, Rev. Dr. John Rusk, and Mr. Girling will speak on the subject of "Homes for the People." This service in one of the best known churches in Chicago on the first Sunday in the new year, will mark an era in the development of practical work in behalf of those who are trying to secure homes and become self sustaining and independent.

Industrial Colonies may be Organized.

The great interest that has been aroused has been shown by the large attendance at the weekly meet-

ings, and by the hundreds of letters showered upon the secretary from persons scattered over the country from Florida to Washington, and particularly by the numerous requests that the Association shall organize a "model industrial colony." This matter has not been definitely settled although it is under consideration, and the Association may decide that it can best serve those it is seeking to benefit by undertaking as a part of its public work, the supervision and organization of a series of small colonies. These colonies if undertaken will be used to demonstrate the practicability of transplanting the average city resident, professional man, merchant or mechanic, to country homes, and under what conditions he will be most successful. The details of the plan have been submitted to people well informed in matters of emigration and have been declared perfectly feasible, and in fact in advance of anything thus far presented to the public. These colonies will be conducted upon a basis of actual cost with a small allowance for unforeseen contingencies. This will be an excellent opportunity for the friends of irrigation and the West to place before the Association their claims to one or more of the colonies.

The Irrigation Congress. The Fifth National Irrigation Congress has come and gone. It entered upon its duties at Phoenix, Arizona, December 15, and adjourned December 17, 1896. Its principal work was the location of the next congress at Lincoln, Nebraska, where an opportunity will be given of showing what the semi-arid region has been doing in the matter of irrigation. The attendance was as large as could have been expected, and the interest manifested was equal to that

shown at the Albuquerque congress a year ago. The date coming so near the Christmas holidays prevented some people from going who might otherwise have attended, and, as was stated in these columns in September, the lack of meetings throughout the Northwest during the summer, resulted in an exceedingly poor representation from that section of country, although the few delegates who were present ably acquitted themselves, and in a measure compensated for their scarcity in number. Another regrettable fact was the meager reports which appeared in the newspapers, not as much space and attention being given the congress as was devoted to a convention of Sunday-school workers in Boston recently, and, without in any sense meaning to belittle the Sunday-school convention, its importance cannot be compared with that of irrigation; the reclamation of the Great West; the making of homes for millions of contented and industrious people; the creation of new industries and the founding of a new civilization under better and nobler conditions for the average man. In order to interest the general public, and especially the Eastern editor who usually looks with suspicion on all matters of Western origin, it is necessary to organize a propaganda and carry on an active warfare with public meetings, such as the irrigation mass meetings which were held in New York, Boston and Chicago in the spring of 1895; and to bring to bear every possible influence to show that irrigation is a living, breathing *National* issue, not merely a local matter pertaining to Utah or Arizona.

What It Aimed At. The Irrigation Congress of 1896 will go down into history as the congress that tried to do something. It was purposed to formulate a definite and settled policy regarding the public domain, the reclamation of arid lands, the conservation of the water supply, and to present and pass judgment upon bills regulating the settlement and use thereof; to recommend some settlement of the disputes regarding international streams; to recommend such legislation as was necessary in each of the seventeen arid states and territories to secure the wise control and use of water for irrigation; to deal with the preservation of the forests, and the reservation by the Federal government of reservoir sites and

the construction of dams thereon, to organize a lobby to visit Washington and influence legislation in favor of western interests, and to provide a fund for the expense of such a committee. It was intended to confine the Fifth Congress strictly to business and not to running off on excursions, and wasting time on public dinners and speeches; it was expected that it would be more largely attended than any of its predecessors because of the growing interest in the subject and also because of the reputation for integrity and ability that characterized some of the leaders of the movement. The expectations of the public were, it is said, raised to fever heat and the convening of the congress watched for with many anticipations of the great good it had an opportunity of doing in behalf of arid America; it was also purposed to more closely cement the friends of irrigation into an association which would have rules and regulations and a membership fee. This last purpose was accomplished. An association was organized with 103 members each one of whom paid the fee of \$1.00.

Some Practical Results. Some of the papers presented before the congress were prepared by men of more than ordinary ability. They are confined to problems that are of the utmost importance to the development of the West. They treat of practical questions in a practical way and they should be carefully studied by those who were not so fortunate as to be present at their reading. A couple of them appear in this issue of *THE AGE*, entitled "Immigration into the Arid Regions," by John E. Frost, Land Commissioner of the Santa Fe; and "Irrigation in the Eastern States," by F. H. Newell of the Geological Survey. Several more of the most important addresses will appear in early issues of *THE AGE* and altogether they constitute the greatest practical benefit derived from the recent congress.

The New National Committee. The congress elected the following named to be officers for the ensuing year: Chairman of the executive committee, E. R. Moses of Great Bend, Kan., re-elected; Vice-Chairmen, Brigham Young of Utah, and E. G. Hudson of Illinois; treasurer

A VALLEY IN SOUTHERN CALIFORNIA.

ELWOOD MEAD,

State Engineer of Wyoming, Cheyenne.

M. G. Utley of Rhode Island; national lecturers, J. Emery of Kansas and I. A. Fort of Nebraska.

The national committee chosen embraces Arizona, James McClintock; California, J. D. Schuyler; Colorado, L. Kellogg; Connecticut, J. B. Abbott; Idaho, F. J. Mills; Illinois, Dr. Clarke Gape; Iowa, Professor J. D. Budd; Kansas, J. H. Churchill; Maryland, G. W. Garrett; Montana, S. M. Emery; Missouri, H. C. Weber; Michigan, Fred B. Spread; Minnesota, T. M. Frost; Nebraska, A. G. Wolfenbarger; New Mexico, C. P. Fancher; New York, Dix W. Smith; Nevada, L. H. Taylor; North Dakota, W. W. Barrett; Oklahoma, Professor Henry E. Glazier; Ohio, B. F. Shuart; Pennsylvania, George W. Alpert; Rhode Island, M. G. Utley; Texas, W. S. Marshall; Utah, L. W. Shurtliff; Washington, L. S. Howlett; Wisconsin, J. E. Godding; District of Columbia, Judge Emery F. Best.

Land and Water. The question of right and title to land, and the necessary water for the irrigation thereof, is of the utmost importance in all our Western States. It is a question which has been discussed many times, but no adequate solution has yet been found, at least none

has been crystallized into a law and placed upon the statute books, either of the various States or the Nation at large. This condition cannot exist forever; it is working a grave injustice to those already settled on arid land, and to those who are crowded into the large cities unable to find employment and support for themselves and families, while the public domain, rich to bursting of nature's wealth, is lying unoccupied and unused. As long as the title to public land remains in the Federal government and the right to sanction the use of water in the various State governments, this vast heritage of the people will remain unoccupied. This question has been solved and re-solved by those laboring for the public good, as well as those with an eye single to a personal interest; it has been strained through a sieve, which like the grist from the mills of the gods is "exceeding fine," but no general solution of the anomaly of two distinct organizations controlling nature's resources, land and water, the combination of which is so absolutely essential to successful agriculture in the arid regions, has yet met with sufficient popular favor to recommend it to our learned legislators at Washington.

JOHN E. FROST,

Land Commissioner A. T. & S. F. Ry. Topeka, Kansas.

the water supply. That no extensive and continued or permanent development of our Western States is possible until the control of both land and water is vested in the local government, is the conclusion drawn by Mr. Mead. Even the Carey Law, of which so much was expected, according to Mr. Mead will fail to fulfill expectations and is far from being adequate to the needs. Mr. Mead makes some first-class suggestions as to remedies, and one cannot read his address without feeling that he has thoroughly studied the question of the arid public domain and its ultimate reclamation. Without entering into a detailed discussion of this address (a printed copy of which can be had for the asking) *THE AGE* wishes to register its endorsement of the cession of the lands to the states and of Mr. Mead's suggestion that a certain acreage of grazing land should be allotted and rented to the man who irrigates. This will do much to lessen the friction between the cattle man and the farmer, and will be unjust to neither.

WM. H. MILLS,

Land Commissioner, Southern Pacific R. R., San Francisco, Cal.

Litigation That the right to the **Multiplying** water should become appurtenant to, and inseparable from the land, has long been recognized, but the problem is how to bring this condition to pass. Feeble attempts have been made by the legislatures of some of the States, but the entire series of laws now existent can be said to be nothing more than efforts toward a solution, some of them worthy and many unworthy, and the litigation which is growing out of this chaotic state of affairs has become alarming in its magnitude and disastrous in its effects. And the end is not yet in view even with a long range telescope.

Elwood Mead's Address. The cession by the Federal government of the arid public domain to the States in severalty has again become an issue after lying quiescent for nearly two years. In an able and scholarly address before the American Society of Irrigation Engineers at Denver, December 12, Elwood Mead, State Engineer of Wyoming, carefully reviews the problem of the arid lands and

WASHINGTON MESING.

(Chicago's Popular Postmaster, Who Has Taken an Active Interest in the Work of The Homeseekers Association.)

IMMIGRATION INTO THE ARID REGIONS.*

BY JOHN E. FROST.

WHSOEVER takes up the subject of immigration into the Arid Regions studies the causes which produce emigration from populous regions or congested social centers and those things which attract to the west, where our arid regions are, naturally thinks at once of irrigation as a prime factor in the problem because the word "arid" precludes the idea of rain farming, and farming in some shape and to some extent is a necessity in the successful settlement of the west, and farming without water is a lonesome, not to say dry business.

"Water is the mother of the vine."

"The nurse and fountain of fecundity,"

"The adorning and refresher of the world."

So we must have water in the arid regions and as the clouds refuse to give it, it must be supplied artificially, hence the important bearing which irrigation has upon the settlement of the arid districts.

There are in those regions vast mineral deposits, practically all of the precious mineral deposits of the country, coal fields almost beyond measure and lead and copper in fabulous quantities and, of course, the development of these resources, the mining, handling and shipping of these minerals will attract and support a large population, but in order to bring this about quickly, development must be accelerated and greatly increased, and farming operations in commensurate proportions must accompany this development. The miners, the engineers, the mechanics, the operatives of the smelters and stamp mills and employes in all lines allied to those interests must have farm products at living prices. At the inception of mining camps and for a time in their early history while great excitement exists very high prices for all farm products prevail, but if growth is to continue, if the camp is to become a permanently prosperous, substantial and progressive region, these prices must drop

*Address on "Immigration into the Arid Regions" delivered by Mr. John E. Frost, Land Commissioner of The Atchison, Topeka & Santa Fe Ry., at the Fifth National Irrigation Congress, Phoenix, Arizona, Thursday, December 17th, 1896.

to a reasonable basis, and to bring this about the bulky and heavy farm products must be produced within a reasonable distance, and this fact necessitates irrigation ditches all over this vast arid domain and renders possible, with prudent management, their success as financial ventures. The fact that so many irrigation enterprises have been unprofitable proves only that there is something wrong which can be remedied. I think that the failures, except in cases of gross blunders or dishonesty, have in practically every case been due either to inability to control the land under them, or where the land was controlled, to holding the land and water at too high prices. Successful irrigation systems offering land and water at reasonable prices, will undoubtedly attract settlers to the arid regions, hence an important step towards the peopling of these districts is such modification of public land laws as will encourage irrigation enterprises by enabling them to control a solid body of public land under their canals, and thus inseparably attach the water to the land. The self-interest of the owners of the enterprise will do the rest. They will have to sell land and water at such prices as will tempt farmers to buy or they will be forced into bankruptcy and a receiver will do it for them. The Carey law is found to contain serious defects and should be amended and the desert land law should be repealed.

The recommendations and influence of this body will undoubtedly have weight with the U. S. Congress and careful thought should be given to decide upon such recommendation of changes in the public land laws as experience has shown to us in the west to be needed, under the changes in colonization and settlement of the past few years, and proper action upon these lines will undoubtedly have great effect upon immigration to the arid regions.

In order to secure immigration, we must be able to provide settlers with the means of making a living. The develop-

ment of a new mine, the enlargement of operations of an old one, the construction of an irrigation canal, all attract new people to a new country, and if the employment be of a permanent and remunerative character, then the settlers whom you enlist in it become permanent residents. They soon have families about them, become identified with the country and its interests and assist in bringing others in, and in this connection let me say that few influences are so potent in bringing settlers into a new country as letters written by its own people to their friends "back East" telling how prosperous they are and how good and abundant are the opportunities for others to share in their prosperity if they will come out and take advantage of the openings presented. But an important adjunct, a large part of the basis for all this, is capital to initiate and develop these industries which are to bring and sustain the population that we want. Ninety-five per cent of the population of our country is out of balance. Its geographical-subdivision is out of harmony with its centers of population and finance. What you in the arid regions want to secure a fairer population is to pave the way for it by enlisting Eastern capital in the development of your natural resources. We people of the West have not the necessary capital; we are poor, that is poor in pocket, although rich in our minds when we think of the vast possibilities in our grasp, of the latent wealth of the West which can be made to respond to the application of the idle capital of the East. The respective needs of the East and the West are correlative and must be brought together to minister to each others fulfillment. In the East is a superabundance of capital eager for investment, a large and rapidly increasing population massed in overcrowded business centers. In the West millions of raw material calling for development as loudly as anything inanimate can call, and room for all the surplus population of the world. Capital, if assured of safe investment and a satisfactory return of profit, will quickly flow to the regions which promise these things, and immigration and growth will accompany and follow it. What can we of the West do to accelerate and secure this desired movement of capital and population? In the first place, the thing of prime importance is for us to show by our legislation

and by all our utterances, that investments of non-residents will be as adequately protected by law in the West as in their own home localities. With that principle as a starting point, we then, in our respective localities, have but to convince the owner of idle capital desiring investment that the investments we present are inherently safe and can fairly be relied upon to produce much better returns than those at his command elsewhere, and to convince the intended immigrant that we can offer him better opportunities for improving his present condition than can be found elsewhere, in order to secure the capital of the one and the presence of the other. Great aids in this work are state and territorial agricultural societies, bureaus of information and other similar boards, whose duty it is to collect and publish in periodical reports reliable statistics covering the agricultural, mineralogical and other great interests of their respective regions. These reports are invaluable, both for direct use with intending investors and settlers, and as affording data for advertising matter issued by investment companies and others presenting investments, and descriptive of special localities, pamphlets which are disseminated through thousands of agencies. In my work of the past twenty-five years in selling and settling lands of the Santa Fe Railway and subsidiary companies, I have made constant use of such reports. Agricultural colleges, with their attendant experimental stations, state and territorial universities and technological institutes which obtain information respecting the resources and advantages of their fields of labor and instruct how best to utilize them, are important agencies in building up the country and attracting settlement, and should have our heartiest support. Each one of their graduates becomes an intelligent, and in proportion to his ability, a more or less influential missionary in this work, so that their influence is constantly widening.

Local boards of trade and commercial clubs are excellent auxiliaries to immigration work, and local newspapers are powerful forces in this work. Special editions descriptive of special regions, with good pictorial illustrations of attractive and interesting features, are valuable. Your home people send them to the old home friends, and through various avenues they

can be made to reach and interest a multitude of people in the East. Many who now rank as old settlers out here got their first impulse to move West from some such publication.

Our church organizations are powerful agencies in peopling the West. Their work in its various lines goes on so quietly that we come to think of it as a matter of course and scarcely realize how potent a force it is in this connection.

One of the most impelling causes of immigration to the West hitherto has been the vast body of public lands open to homestead entry and the considerable area of railroad grant lands for sale at low prices in the rain belt regions west of the Mississippi river, but the situation is now changed, these lands are now practically all gone, and although Uncle Sam's public domain still embraces, according to the recent annual report of the Secretary of the Interior, six hundred millions acres outside of Alaska, the seeker for a free home now must invade the arid or semi-arid region to obtain the national heritage. Secretary Francis urges upon Congress the need of legislation for the reclamation and disposal of lands within the arid regions and suggests amendment of the Carey law, or placing the lands under the direction of the states, only so far as may be necessary to secure their reclamation for the benefit

of actual settlers. Hon. J. Sterling Morton, Secretary of Agriculture, in his annual report, states that the exported products of American farms during the last fiscal year increased \$17,000,000 over the preceding year, and asks why a nation possessing, as does the United States, the greatest power and facilities for producing and manufacturing things which the world demands, is not destined to monopolize the markets of the globe. President Cleveland, in his message to Congress just uttered, says that the number of foreign immigrants arriving at our ports during the fiscal year shows an increase of 84,731, or nearly 33 per cent. over the previous year.

So the necessities of the times touching the disposal of public lands, the increase in the market for American products, the revival of foreign immigration to the United States, the overcrowded condition of the East, the absorption of the rainbelt districts of the West, all render the present a most favorable period for this body, through its work and influence, to secure now such legislation as will result in the undertaking of irrigation enterprises that will soon place under ditch a great area of public land that is now worthless, and no other action that could be taken would do so much to stimulate immigration to the arid region.

IRRIGATION IN THE EASTERN STATES.*

BY F. H. NEWELL OF THE GEOLOGICAL SURVEY.

IRRIGATION is as wide as agriculture, and not only enters into the diverse branches of cultivation, but also is found in one form or another in nearly every locality where crops are raised. It cannot be shut off by itself as pertaining to a particular climate or locality. There is probably not a section of our country where the artificial application of water to the soil is not successfully practiced, despite the wide range of climatic conditions. Even in cold, damp New England the meadows and grass lands are in some instances watered by systems of ditches; orchards are thus occasionally protected from drouth, and cranberry marshes are flooded, the method of applying water differing little from that in use in the arid states. Coming southerly along the Atlantic coastal region there are to be found small farms, especially in the vicinity of cities, where irrigation is habitually practiced. This is notably the case in truck farming in the light, early soils. For example in the Carolinas and Georgia, where early vegetables are raised for the New York market, it often happens that there is a deficiency of rainfall just at the time when the vegetables should be making their best growth or are maturing. Unless water is then applied losses of hundreds of thousands of dollars are imminent, but with proper moisture given at the right time large profits can be secured.

The flooding of rice fields, though so well known, is often overlooked as belonging to this class of cultivation, but it is properly included under the term "irrigation," as well as all means by which the supply of water is artificially regulated, even though this is in part closely allied to draining. The same kind of problems are encountered both as to lifting and conducting water and also as to the effect on the plants of a surplus or of a deficiency of supply.

Within the Mississippi valley and even

up into the far north in Wisconsin and Minnesota are many fertile soils of a texture such that they do not retain moisture. As a rule water can be found below these at depths often under twenty feet and can be cheaply raised by suitable machinery. The experiments of Prof. F. H. King at Madison, Wis., demonstrate the great increase of crops by the use of water thus obtained.

If we include under the term irrigation the watering of lawns and gardens from city and town supplies, we will have a larger appreciation of the extent to which this method of agriculture is practiced and found invaluable. There is hardly a place of any considerable size where the home surroundings are not made more attractive by the lavish use of water on the grass, trees, flower beds and gardens. These form the best object lessons as to what can be accomplished by the employment of plenty of water at the right time. A corresponding luxuriance of growth can be obtained by field crops under like conditions. Let the farm be supplied by gravity systems, or by pumps or storage works so built that it can receive at moderate cost a large enough quantity of water when needed, and the farmer can with due intelligence and energy rival the prize crops and be sure of large returns, whether the rains come or not. In the deliberations of the Irrigation Congress we must recognize the east if we claim to be national in character. To maintain the larger relations we should meet occasionally farther to the east than before, and show a proper interest in development in all parts of the country, whether the climate be humid or arid, co-operating with all other agencies seeking to promote a larger and better use of the national resources in soil and water.

* Extracts from remarks before the Fifth National Irrigation Congress.

THE ART OF IRRIGATION.

CHAPTER XVIII. THE AMOUNT OF WATER REQUIRED.

(Continued)

By T. S. VAN DYKE.

WHILE the acre foot is the best way of estimating the amount of water used in irrigation, because it counts the water actually put upon the land as shown in the last chapter, there will still remain a great difference in the quantity used in different sections and by different irrigators in the same section, even side by side and for the same crops. And each one will be quite positive that his way is the best, while many will claim that they are cheated out of some water even if they use a foot to the acre.

The extremes of the use of water seem a cubic foot a second to about eighteen acres on the Rio Grande about Albuquerque, embracing all the lands under the old ditches for miles above that point and some below, to a foot to about two thousand acres at Pasadena in Southern California. Pasadena has an average rainfall of about eighteen inches, most of which enters the ground, while on the Rio Grande it is practically nothing. But this does not begin to account for the difference. Both these estimates are made by dividing the acreage served by the amount of water in the aqueducts. Both the acreage and the amount of water are subject to some errors from measurement, but not enough to affect the result very much. And as all other ditches in the land are in the same condition, as far as knowing exactly the amount of water or land, these are as good data as can be had.

WATER FORTY FEET DEEP.

The ridiculous nature of the irrigation on the Rio Grande is seen in the fact that a foot a second would in a year cover eighteen acres about forty feet deep. But counting only by the irrigating season of say six months, only half that would be put on. But this would be twenty feet in six months, or forty inches in depth per month. Allowing as much as ten per cent.

of waste at the lower end of a tract to insure good wetting of that part, and we still have thirty-six inches, which would be a larger rainfall than any part of the United States has during the whole growing season, and would be equal in effect to twice that amount of rain as it usually comes. This is three acre feet a month, or more than some of the best irrigating sections use for the whole year for anything but alfalfa, and more than most of the prosperous alfalfa sections use during the six months of summer, five feet for the whole year being about the outside figure for those who make any extensive business of it and understand it the best. This estimate of the duty of water on the Rio Grande was made with much care by an engineer of that section for his own information, was stated in a paper read to the Irrigation Congress at Albuquerque, and was considered correct by those there best qualified to criticise it. It is instructive for three reasons:

It shows the absurdity of taking the duty of water in that way.

It shows what progress may be made in irrigation in four hundred years by people who do not travel and study what other sections are doing.

THE MISTAKES MADE.

It shows what a big fool the great American citizen of the tenth decade of the Nineteenth century can be, for all up and down the Rio Grande, where he is trying to irrigate at all, he is following very closely the old methods of the first Indian settlers, without the slightest suspicion that any other part of the United States has learned anything of late years. When you look at the region under the ditches along that river you will not wonder that Mexico is clamoring for the water that used to come down to the line. Thousands of acres of the most fertile land, under a

splendid sun, for growing almost anything that can be grown at that elevation, are alkali-ed almost to the point of being worthless; thousands more have the crops drowned or overgrown with weeds that grow while the crops are held back by the drenching. Everywhere in the irrigated sections you find bog holes and sloughs in the roads made by the water wasted from the fields. In some places the crops on well drained ground are good enough to show what they might be if properly treated. Nowhere are they better than that. Everywhere there is waste and muss and ruin enough to sicken anyone who knows what good irrigation is and knows what that fertile valley could yield if water were properly used.

THE EXAMPLE OF PASADENA.

The case of Pasadena is almost as bad on the other extreme. I know places where even less water than a foot to two thousand acres is used, but they are scattered patches and do not afford as good an instance as Pasadena, because that is under a land owners' company where the distribution is well managed and is a solid and flourishing city of some fifteen thousand people. It is instructive, not as an example to follow, but for the principles involved in the showing it makes on so small an amount of water.

Pasadena started some twenty years ago as a small settlement for the growing of oranges and other fruits, some nine miles from Los Angeles, California. A small but quite reliable supply of water was flowing all the year in Arroyo Seco above the settlement, but not supposed more than sufficient for a thousand acres or so. The beauty of the situation and the success that attended the cultivation of the orchards before the great boom set their owners crazy and made them cut many of them into town lots, increased settlement and extended the area very rapidly. The water supply has been constantly increased at times, but was entirely unable to keep pace with the rate of settlement, which went ahead in spite of the collapse of the great boom. It is now a beautiful city with hundreds of fine places, and though it can no longer be called a productive place, as compared with other settlements, there are still hundreds of orchards that

would produce very well with a little more care. At a time when its water supply was not over a foot a second to fifteen hundred acres, measured by the year, or an inch to thirty acres, the orchards repaid their care, though by no means as profitable as they might have been with more water. They looked fine, and to the eye of a stranger there was nothing lacking. To the eye of an expert or fruit buyer there was a considerable shortage of the higher grades. Nevertheless they were unquestionably profitable for several years where carefully managed, and especially where the owner did as much of his own work as possible. Now, with even less water, the orchards look well to a stranger's eye, and most of them now pay interest on a valuation of several hundred dollars an acre, where the owner takes good care of them and does his own work.

MOISTURE RETAINING SOIL.

But it must be remembered that the winter rainfall is here heavy enough to raise good crops of corn on the upland, with every grain planted after the last rain, and the soil is so retentive of moisture that with cultivation alone good crops of deciduous fruits are a certainty in most years. The general yield is much increased by irrigation, which is indispensable to any marketable crop of oranges, but it is still so far short of what it should be as to prove it folly to try to work the soil for profit where the water is so limited, when there are so many other places where there is plenty. If you want profit go where the water is. Yet this place proves plainly the folly of drenching the ground continually.

It is certain that with double the amount they now use, or three-quarters of an acre foot, instead of about three-eighths, they could raise everything except oranges, lemons and alfalfa with the highest success. With an acre foot they could raise these three very well, and with a foot and a quarter make a fine success of them, reaching very near the highest with a foot and a half. Two feet for the oldest and most heavily laden trees would be ample. The irrigation is now generally limited to basins, because there is not water enough to give heads large enough or long enough for flooding or furrows. By good culti-

vation this is made to do the largest amount of duty and makes the whole an instructive study, though not a good model for one who wants money first and beauty afterward.

BETWEEN THE EXTREMES.

Between these two extremes there is a wide range of cases quite as useless as guides. On the one hand we have the man with a windmill and some wonderful spring or artesian well who is trying to spread the scanty supply over as large an area as possible. He always has "All the water I want." If he has some dry land to sell outside he is sure to have more than he wants, and discourses very learnedly on the evils of too much water. He will lie most grandly about the profits he makes, or if he admits there is no profit in it it is the fault of the market, of the railroads, or the middlemen, or anything but want of water. On the other hand we have the man who has to pay so much a year for his water any how and is trying to get his money's worth, with a dozen of the other varieties of human nature that the ownership of land under a ditch develops, the principal one of which is to want all you can get and a good deal more, and to run it over the ground if it won't go in, so as to be sure you have got so much ahead of the other fellow who claims a right to some of it. Then charge this waste up against the duty of water and depreciate your section by making capital believe that hundred-dollar-an-acre water is indispensable to success on land that won't bring seventy-five dollars after the water is brought to it.

IMPORTANCE OF SUBSOIL.

From what I have said about winter irrigation, the soaking of the ground by long and heavy winter rains and the influence of such soaking on the crops even eighteen months ahead on lands having a very deep and spongy subsoil, it must be plain that the duty of water will depend very greatly on the nature of the subsoil and the condition of moisture in which it is kept. A dry and uncultivated piece of ground will take out the moisture from an irrigated piece adjoining it with surprising rapidity for several feet past the line of junction. A dry subsoil will act in the same way. If two feet of soil are wet by a flooding, but below that the soil is dry,

that dry portion will take away the moisture faster than will the air above. The rapidity and extent of this process will depend upon the depth, texture and dryness of the subsoil, but it will in any case be rapid enough. This difference is plainly seen now in Southern California. It is now passing through the summer after one of the driest winters on record. Two years ago it was about as dry. But then good crops of grain were raised all over the greater part of the uplands, while fair corn, planted after the rain was over and never irrigated, was a common sight, though the winter rain had been less than half the average. Now with the same conditions of preceding winter, nothing of the sort is possible. The difference is that the winter two years ago had been preceded by a long series of good winters, none of which were very short, and several heavily above the average. These filled up the subsoil and kept it filled. This last winter was preceded by one a little below the average and that by the dry one above mentioned, so that the subsoil on the uplands is almost as dry as on the desert. Were it not for the great mountains that have so much more rain and snow than the lowlands, this part of California would be in a very bad condition this year. As it is, those who let the winter water run to the sea, because they thought the planting of trees had "changed the electrical conditions," so that this section would be an exception to all the world in having no droughts, will find before the summer is out that their trees will need much more water than they have ever done before. The same thing occurred in 1883, which was the third of three seasons, the first two of which were scarcely up to the average, with a distribution that put little water into the subsoil, while 1883, the last of the series, was much below the average.

There seems no exception to this rule, even along those portions of the seacoast where there is considerable fog at night and the day is never very hot. Moisture in the air undoubtedly effects vegetation, as is plainly seen in the east by the untwisting of the leaves of suffering corn in a rising storm before the rain actually reaches it. Putting water on the leaves has somewhat of the same effect. But these are more in the nature of stimulants or rather like the smell of whiskey to a

dry old toper. They will not help out much of a crop on a dry subsoil.

On the desert many a crop suffers in this way. At the first irrigation, after being dry for ages, it is wet down say four feet. The irrigator thinks this enough. It may be if the sheet water below is near enough to furnish moisture by capillary attraction. But in some soils moisture does not rise in that way one-quarter of the height it is generally supposed to, and in very fine soils does not rise one-half. Sheet water is a fine reliance for many things, if you are sure you have it and sure how high the moisture rises. But until you are positive on this point you had better put into the subsoil all the winter and spring water you can, unless you are certain it will damage the crops. And in irrigating desert for the first time, if it is many feet to water below, you can hardly get too much in. If you should put in two acre feet per month for the whole first winter you might have the top a little too wet for the first crop, but

the succeeding crop would be better than if you had to fight a dry subsoil. When the subsoil is once thoroughly soaked it is quite an easy matter to keep it so. But a dry one is the last thing you want to fight. You can beat the dryest air and hottest sun with water on the surface and good cultivation of the top soil, but if the subsoil is sapping the moisture all the time you have a hidden enemy that is worse than the open ones.

When you have investigated this subject thoroughly you will reach the conclusion that for all around good results a subsoil that will hold moisture—not water but moisture—is very essential to the best cultivation of the soil for field, garden or orchard, and that its condition needs watching almost as much as that of the top soil. And nothing will so enable you to get along with little water at the time of year when it is scarce like keeping this well filled at the time of year when water is plenty and no one wants it.

THE FARMERS NICHE IN OUR CIVILIZATION.

BY W. C. FITZSIMMONS.

EVERYWHERE and in all times the husbandman has stood as the corner stone of individual progress. Upon his broad, unwearying and patient shoulders has been upreared the industrial fabric of the world. Amid all the vicissitudes of individual and national life and advancement the farmer has ever remained and still is the indispensable factor, without whose arduous and unremitting toil human society cannot exist. At the gateway of all possibilities in human achievement stands the farmer, and without his consent and co-operation the chariot wheels of progress must stop. From the soil all things must come; to the soil all things must sooner or later return. While all this is true, it is equally true that the farmers have never yet, as a class, taken rank in the modern scheme of things in accordance with their importance and relative value. This is as true in the United States as in other countries, though perhaps in lesser degree. The agricultural classes have been slow to assert themselves and others have traded to their own profit on the modesty of the farmer. Although outnumbering any other class of workers in this country, the farmers have been so long accustomed to allowing others to dictate to them in nearly all things relating to their own interests, that any self assertion has come to be branded as an impertinence by men of other avocations, and even by many of their fellow workers on the farm.

That there is evidence of a coming radical change in this respect is hopefully admitted, although the awakening is late, and less thorough than it should be. Other interests representing commerce, the law, medicine or divinity, are not slow to assert their importance in any and all places, and each takes an especial care to hold a patronizing attitude toward the tiller of the soil. Even the farmers themselves contribute to the prolonging of this condition by meekly submitting to the dictation of nearly all other classes of men, in matters pertaining to politics, business

and social conditions. The man who spends most of his time sitting upon a cracker barrel, but sells a few pounds of cheese and sugar, or a basket of eggs occasionally, as proprietor of a country grocery, is a "business man," while his neighbors are "merely farmers." These may seem trivial affairs and so they are; but just the same they represent a condition which the educated American farmer should have the courage and spirit to persistently and effectually resent. The dignity of his calling should always be defended and insisted upon, but his own relation to his pursuit should not be such as to render his protestations ridiculous. The schoolmaster who should express pride in his avocation, in ungrammatical phrase would merely excite a smile, and the doctor who should extol his skill while attending his patient's funeral would scarcely add to the public respect for his profession. The weed-grown farm proves a bad text from which to preach reform in the national finances, and tumble-down buildings and fences are no argument in favor of sending farmers to Congress. To be brief, the American farmer needs more education, more intelligent devotion to his pursuit and then more self assertion.

He should first know his own business thoroughly and then allow no man to dictate to him in relation to it.

At present all farmers depend upon some one else to tell them the value of their commodities. A farmer enters a store and inquires the price of sugar or calico. He also asks what the merchant will pay for potatoes or pork. It is probably not too much to say that right here is the weak place in all agricultural pursuits. The very fact that the farmer allows another to fix the value, not only on what he has to buy but what he has to sell also, accounts, in large measure, for the condition of comparative dependence in which the farmers find themselves. We hear much of the "independence" of the average farmer. It is a myth. The farmer might be, but is not independent.

As above stated, if he wants a pound of cheese he asks someone else what he must pay for it, and if he wishes to sell a dozen of eggs he asks the same man what he must take for them. American farmers must rise above this condition or they will never command a proper place in the business, social or political world.

How are they to do it? It is always easy to criticise a state of facts, but not always easy to suggest a remedy for it. But certainly a road is open to the American farmer and it is as clear as a turn-pike. Do business on the farm in the same careful manner that it is carried on in the store or the factory. Know the cost of every article produced, and know what it should be worth in the markets, taking into account all the conditions affecting its production and sale, as the amount produced, cost of transportation, and all the other factors of a problem which can be as easily solved by the farmer as by the merchant, if the former will but devote the necessary time and talent to its accomplishment. The example of the men who plowed under a part of their wheat crop, in Kansas, in order to increase the price of that staple has been previously cited in these columns. Such a performance, though infinitely puerile and absurd, is, nevertheless, a most excellent object lesson showing the petty provincialism of some farmers who have the unhappiness to believe themselves well informed. Some wag years ago related an amusing anecdote of the late Horace Greeley, which of course was not true, yet seems to show the kind of wisdom that sometimes commands a premium even among farmers. The story was that a young man wrote to Mr. Greeley from Colorado asking him to recommend a proper course to be pursued in improving the breed of his sheep. Mr. Greeley promptly replied that the young farmer should import a good hydraulic ram from Vermont for that purpose.

The main purpose of this article is to impress upon the American farmers the important nature of their calling and to suggest ways and means of properly upholding the dignity which by right of its essential nature belongs to it, especially in the United States.

Don't plant onions on ground where potatoes were grown the previous year.

Prof. Roberts says, "I would as soon deposit \$50 in a bank week after week, knowing that no account was kept at the bank, as to run a dairy without knowing how much each cow gave me and how much it cost me to get it."

The continuous soaking of land or crop is sure to result in injury. One cubic foot of water per second will cover an acre one inch deep in an hour.

Remember that wherever water can be obtained there trees can be made to grow. The irrigated farm should be the most beautiful.

The mountains are full of snow, the rivers of water, the East of capital, and the farmer ought to be full of hope.

A patch of sweet corn makes one of the best crops to grow to commence feeding hogs intended for an early market.

In market gardening don't try to grow too much; the result is always poor vegetables and half a crop.

One cubic foot of water a second is the same as $7\frac{1}{2}$ gallons every second, or 450 gallons in a minute.

Don't try to farm more acres than you have water for. Give irrigation a fair chance.

Before the end of another year the rain-belt farmer will admit that he "ain't in it."

Alfalfa and small grain make a winning team anywhere in the irrigation empire.

Tobacco thrives well on irrigation.

WHAT IRRIGATION DOES.

Irrigation
Reclaims arid wastes.
Makes a prosperous country.
Insures full crops every season.
Is the oldest system of cultivation.
Increases the productive capacity of the soil.
Destroys insects and produces perfect fruit.
Creates wealth from water, sunshine and soil.
Makes the farmer independent of the rainfall.
Will redeem 100,000,000 acres of arid and desert lands.
Will yield support to 50,000,000 population.

WILL CAPITAL BE TREATED FAIRLY.

BY D. W. ROSS, OF IDAHO.

UPON the theory that the federal government will not build many irrigating canals for us during the coming year, a few reasons why our next legislature should continue the good work along the line of irrigation legislation begun by the last will perhaps not be out of place at this time.

For several sessions past bills have been introduced for the regulation of the use of water for irrigation, but they were of local character, and no general scheme for ownership and control was proposed until the last session, when a law similar in character to the "Wright law" of California was enacted.

The principle of common ownership of land and water was also incorporated into the act passed at the same session, accepting the grant of one million acres of land from the United States. Thus the foundation was laid, it was hoped, for future legislation.

Several "districts" were formed under the "district law," but owing to doubt as to the decision to be rendered by the United States Supreme Court on the validity of the "Wright law" all work was held in abeyance.

All right-thinking men, however, have agreed that we have started in the right direction, and with a few amendments our irrigation laws should be operative for great good.

In answer to the pertinent question, "Will capital be treated fairly?" I desire to explain operations under our "lack of system," which, I trust, will convince thoughtful men of the necessity of a radical change in our present policy, a policy which has retarded settlement and which threatens the good name of the state.

The "promoter" has always been an important man in the development of new countries. In Idaho the "Irrigation Promoter" has held undisputed possession of the field of irrigation enterprise. No laws have yet been passed circumscribing his actions, but he has stood before our legislative committees and in the name of "capital" has objected to every class of legisla-

tion on this important subject. Starting with a proposition based upon wind and water, the water belonging to the state and the wind his own, he has succeeded in making more colossal failures than any other public figure.

Two important reasons will account for such failures. First, he attempts to arbitrarily establish certain relations between the land owner and his water company; to this the land owner objects; and second, in a few cases, the project has been wrecked because the promoter tried to make his profit out of the capital, which necessarily passed through his hands during the construction of the works. While there are a few successes due to his fairness and honesty, the above reasons will account for most of the failures of irrigation enterprises in this state.

The promoter has been given a free hand, his reports in many instances will not stand investigation, and, taking into full account "hard times," the policy adopted through his representations promised nothing but disaster. Yet he has been abetted by many prominent citizens on the plea that we will reap great advantages through the "expenditure of capital." In the attempt to mitigate the wrong done capital all manner of colonization schemes are placed before the people, which in many cases have only added new victims.

There has either been an exception to the proverbial "timidity of capital" in the case of irrigation investments, or the irrigation promoter is the prince of charmers. In all large undertakings of this class capital is absolutely necessary. It is generally supposed that capital's first inquiry is regarding the security offered. Whether the profits of the promoter be great or small, whether the relations between the management and patrons be cordial or strained, is of but little moment to the holders of the bonds, provided the security for said bonds is good.

With the constitution of the state before him, which declares the use of appropriated waters to be a public use and within

the control of the public, without the adjudication of a single right on the stream, without a contract signed with a single land owner, the patron of the proposed company, with a duty for water fixed arbitrarily, the promoter has induced capitalists to expend millions of dollars in these enterprises, many of which can only promise loss.

In every case the security for bonds rests upon the toil and thrift of the land owner, but between the owner of the land and the owner of the bond an understanding does not exist. They have not yet met.

The *title* and *right* to water under our constitution rests in its *use*. The value of the security for the capital invested in the works also depends upon the use of the water, for the carrying of which the works were constructed.

When the ownership of the works are vested in a company and the ownership of the land to be watered in numerous individuals the plan of operations has always been about as follows: To demand a subsidy from the landowners, the amount and conditions of said subsidy to be fixed by the owners of the works. This subsidy is known as a "water right" which by its conditions places a perpetual obligation against the land in the shape of a fixed annual cash rental for water, in many cases whether water is used or not.

It is generally expected that this amount received for these so-called water rights would at least pay the first cost of construction and handsomely pay the promoter if he has not already taken his profits from the proceeds of the sale of the bonds.

This is the outline of a well-known plan of procedure on the part of the promoter of the enterprise and this nicely put upon paper is the security offered for bonds.

The only element lacking to make this a gilt-edged security is the consent and co-operation of the landowners, by whose thrift alone can the bonds become a good investment. But the landowner is not a party to the bonds, the mortgage being against the works and not the land. The so-called water rights which have been paid for in full being released from the mortgage, adjustment of rates being within the jurisdiction of the courts and the constitution of the State declaring that use of the water entitles the landowner to

a continued use of it, the query is who will pay the bonds?

It is hoped that under our new laws the security offered will not be a fanciful dream nor a schedule of net earnings, but the *irrigated land itself* and the pledge for the return of capital and interest will be given not by an impecunious promoter but by every owner of land under the proposed works.

All the readers of *THE AGE* are acquainted with the "Wright," or "District Irrigation Law," and all appreciate the importance of the recent decision of the Supreme Court which declared it valid. Now that this law is operative we hope to make it, First, the means by which the farmers of Idaho may build and control their own irrigation works, and second, afford a perfectly safe investment for capital. Already steps have been taken for the first, and the second will be best effected by placing the entire matter under State control.

When all conflicting rights to public water are properly adjudicated; when the financial and legal status of companies and Districts and the rights of individuals are passed upon by our courts before outside innocent parties are involved; when estimates and plans are approved by the State Engineer before work is begun, then will we invite the confidence of investors, for our irrigation enterprises will be backed by the thrift of the farmer and the integrity of the State.

In this class of legislation as in all others thoroughness in the work of drafting the law is of paramount importance. No emergency exists, therefore it will be best to go slowly.

Let us build upon the foundation principle of common ownership of land and water (which has already been laid), a system perfect in all its details which will guarantee the greatest good to the greatest number, besides offering a security to the investor as good as a *government bond*. Then will capital be treated fairly!

SOME GOOD POINTS.

Have a care in irrigating carrots and parsnips, as they are ruined if water is near them too long. Root crops give the best results by being sown on ridges from three to five inches high. This method insures a larger and finer root.

An orchard once planted will not take care of itself. It must have close attention to every variety of fruit. Remember that you are trying to grow fruit, not wood.

Set the trees in an irrigated orchard so that those requiring the least water will receive the least, and vice versa. The cherry needs the least and pears and apples next, in the order named. It is well to give apples plenty of water the first season after planting. Give the gooseberry, strawberry and currant plenty of water. The blackberry and grape will do nicely with little.

LARGE CANALS IN THE SOUTH.

The Marion Steam Shovel Company have recently made sales of three of their large Ditching Dredges to be used in constructing a canal in the South. Two of these Dredges have sixty-foot booms and very large hulls, with vertical spuds: the third one is for a lateral, and has a forty-foot boom, with their patent bank spuds.

This Company are now very busy on this and other orders. They manufacture a full line of excavating machinery, both Steam Shovels and Dredges, and suitable for all earth displacements. They have the largest and best equipped plant in the United States for the manufacture of this line of machinery. The officers of this Company are men who got their experience from actual work as steam shovel and dredge engineers, having had from eight to twenty years' experience in that capacity. From this experience they were enabled to get the weak and the strong points of all the machines manufactured, and to improve on the strong points and eliminate the weak points from their own machinery. Among their strong claims is that of simplicity of design, as they get the same results with very much less complicated machinery than is generally used. Their office and works are located at Marion, Ohio, and they would be pleased to answer all communications relative to their line of machinery.

HOT AIR ENGINES.

It has been demonstrated in many Western States that the water supply is collected in basins formed by impervious strata, giving an inexhaustible supply of water. All that is necessary to bring the

hidden rivers to the thirsty fields is a method that can be depended upon for swiftness and be sure and steady. A recent invention in pumping engines, with simply hot air for power, insures a supply equal to almost any demand. The capacity of a DeLamater Rider or a DeLamater Ericsson Hot Air Pumping Engine is from 1,500 to 30,000 gallons of water per day, which can be piped to any part of the farm. These engines require very little heat to run them, have no valves, do not require steam and are so safe that a child can run one. The manufacturers will ship an engine to responsible parties subject to approval, and anyone interested should write for catalogue and particulars. Address The De Lamater Iron Works, 467 West Broadway, New York, N. Y.

ELECTRIC POWER STATION.

The new power company at Niagara Falls have now in successful operation their new power plant, consisting of four of the Leffel celebrated Niagara type of Turbines, each of about 2,200 horse power capacity, or giving in all some 9,000 horse power. These Turbines drive eight generators of something over 1,000 horse power each; generators being connected directly to the shaft of each wheel, one being placed on each side.

This comprises the most complete and perfect electric water power plant in the world. The same company have four other of the Leffel Niagara Turbines, using in all eight of that style of wheel.

A GOOD LAND GRADER.

We have received a copy of the new circular for 1897 descriptive of the Shuart Land grader, from which we cull the following sample testimonial:

MOUNTAIN HOME, IDAHO, Dec. 1, '96.

B. F. SHUART, Esq.,

Dear Sir: I wish to express my high appreciation of the Shuart Land Grader. It has made farming in irrigated districts a pleasure. I would not place a price on the one we have were I unable to replace it.

Very truly yours,

A. B. CLARK, Supt.

We advise all irrigators to send for a copy of this circular. For the address, see advertisement of the Grader in another column.

Clover hay, cut fine and cooked or scalded, makes an excellent mess for the hogs, especially if a small quantity of meal be sprinkled over it. The hog should have bulky food as well as the horse or cow. To feed it on concentrated food exclusively will not bring as good results as mixed diet.

BROWN'S RED BARN.

Us folks of Punkin village have had a monstrous loss—
'Twas not a fine-bred Jersey cow, nor any racin' hoss;
For pesky trifles sich as them we wouldn't care a darn,
But we one and all regret the loss of Brown's red barn.

Of good ole Punkin village 'twas the center and the
pride;

'Twas admired for twenty miles aroun' about the coun-
try side;

Ole Deacon Tompkins' windmill is a smashing big con-
sarn.

But it 'tracted no sich 'tention as did Brown's red barn.

It stood atop of Winnow hill, where neighbor Brown re-
sides.

And letterin' of varus kinds was writ on roof and sides—
For instance, mottoes sich as these: "Try Baxter's pep-
ment gum,"

"Please call at Holt's, in Centerville, for fine New Eng-
land rum."

Before that barn was built a train would give jest one
short toot,

But sence 'twas built each passin' train has gin a grand
salute;

It made the town look city like—its signs and walls of
red

Were jest in city style—at least, so city folks have said.

Las' night 'twas burnt to ashes, and I tell ye 'twas a
sight—

In town and fields aroun' about 'twas more like day than
night;

The Punkin village fire brigade were there and did their
best—

They saved the horses and the cows, but couldn't save
the rest.

The second-handed in line it broke down within an hour,
And arter that to quench the flames was not in human

pow'r;

The hungry flames 'ere mornin' gobbled up the hull con-
sarn,

And to-day there's a naught but ashes left of Brown's red
barn.

—Boston Globe.

OPPOSED GOVERNMENT OWNERSHIP.

The American Society of Irrigation Engineers at its last session in Denver, Colo., adopted resolutions opposing the idea of government action in the building of irrigation reservoirs and canals, but advocating a government commission to look over the arid territory and make suggestions for the aid of the states in the work. The permanent headquarters were established in Denver.

LITERARY NOTES.

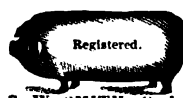
McClure's Magazine will begin in the January number a series of "Life Portraits of Great Americans" with reproductions of all the existing portraits of Benjamin Franklin known to have been made from life. There are fifteen such portraits, and some of them have never

been published. Mr. Charles Henry Hart, probably the highest authority on early American portraits, is collecting and editing the material for the series, and will add introduction and notes giving the history of the several portraits and whatever is interesting in the circumstances of their production. There will also be an article on Franklin by Professor Treat, of the University of the South.

Scribner's Magazine began with January, 1887. The issue for January, 1897, celebrates the opening of a new decade. A great programme has been announced for the coming year, and several of the series will begin in the January issue—notably the series on "The Conduct of Great Businesses" beginning with "The Department Store" described by Samuel Hopkins Adams, of the *New York Sun*, and illustrated from actual scenes by W. R. Leigh.

The Review of Reviews for December publishes a *fac simile* reproduction of President Cleveland's famous telegram to Indianapolis in September last forbidding consideration of his name as a candidate for renomination. This message has been generally misquoted by the press. It is worded as follows: "My judgment and personal inclination are so unalterably opposed to your suggestion that I cannot for a moment entertain it." The telegram was addressed to the Hon. Daniel G. Griffin, chairman of the New York delegation. The *Review* now presents the original autograph as a "foot-note to history."

The Century Co. had accepted Dr. Mitchell's new novel, "Hugh Wynne, Free Quaker," for book publication, and it was to be issued this autumn. A large edition had been printed and advance orders had been received from the trade, when the strength of the story and its probable drawing power as a serial in *The Century* decided the editors of that magazine and the publishers to suppress the book for a year and use the novel first in *The Century*. Those who have read the story consider it not only Dr. Mitchell's masterpiece, but one of the really great American stories.



BERKSHIRE, Chester White, Jersey Red and Poland China Pigs. Jersey, Guernsey and Holstein Cattle. Thoroughbred Sheep, Fancy Poultry, Hunting and House Dogs. Catalogue. S. W. SMITH, Cochranville, Chester Co., Penna.

TEXAS.

In the Agricultural line, Texas leads all other states in the variety of its products. Cotton, corn and the cereals grow and are raised in every section of the state and in the central and southern portions, sugar cane and sorghum cane are profitably cultivated.

On the Gulf Coast two and three crops of vegetables are raised each year. Berries are shipped six weeks in advance of the home crop in the north. Pears, peaches, plums, oranges, figs, olives and nuts all grow abundantly and can be marketed from two to three weeks in advance of the California crops. Large quantities of rice are now grown.

If the land seeker, the home seeker and the settler desires to secure a farm larger than the one he occupies, on vastly more reasonable terms; if he wants more land to cultivate, a greater variety of crops to harvest, with proportionately increased remuneration, at a less outlay for cost of production; if he wants an earlier season with correspondingly higher prices; if he wants milder winters, all the year pasturage for his stock, improved health, increased bodily comforts and wealth and prosperity, he should go to Texas.

Send for pamphlet descriptive of the resources of this great state (mailed free). Low rate excursions via the Missouri, Kansas & Texas Railway every month. Address H. A. Cherrier, Northern Passenger Agent 316 Marquette Building, Chicago, Illinois.

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WHAT SHALL WE DO WITH OUR BOYS AND GIRLS?

Now a Farmer's Daughter Earned \$25,000.00 in Eleven Years.

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THIRD EDITION, ILLUSTRATED.

Acknowledged to be the best help for young people ever published.

It recognizes the fact that the strongest and best business men were reared as farmers' boys, and that the farmers' girls are the best and most useful girls, and that both should be shown the way and helped to rise.

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SAMPLE PAGE FROM
OUR ILLUSTRATED CATALOGUE.



The above is a reproduction from a kodak photograph, taken by Mr. I. A. Fort, President of the Nebraska State Irrigation Society, of a 12-foot Aermotor and Aermotor irrigation pump, owned by S. E. Beachler, Big Springs, Neb. (See testimonial below.)

Fills a Lake 150 feet in diameter, $3\frac{1}{2}$ feet deep, in two days.

BIG SPRINGS, NEB., July 26, 1895.

AERMOTOR Co., Chicago, Ill.

Gentlemen.—Your inquiry of July 23d in regard to how I like my Aermotor mill and irrigating pump, also in regard to crops under irrigation, received. In reply, will say I am well pleased with crops and irrigating plant. My Aermotor is a 12-foot wheel, and have it attached to an 8-inch Aermotor irrigating pump, 20 feet long. My well is dug 5 feet in diameter, 10 feet to water, and 8 feet of water, so I have the pump 8 feet in water, and 4 feet above platform. In a good wind it keeps the well lowered 4 to 5 feet. It will pump $2\frac{1}{2}$ gallons at a stroke, and 30 to 40 strokes per minute.

My reservoir is 150 feet in diameter, and $3\frac{1}{2}$ feet deep. In an ordinary wind the pump will fill it in two days. With an 8-inch pump I can successfully irrigate 8 to 10 acres in general crops, or 25 to 30 acres in alfalfa. Intend to sow 5 to 10 acres alfalfa each year till I have 25 to 30 acres, which I consider your mill will irrigate when it is well rooted down. Had six acres sowed this spring, first cutting July 15th; also have 6 acres in corn, potatoes and garden truck which are doing nicely.

Yours truly,

S. E. BEACHLER.

N. B. A boom is thrown across the center to prevent the force of the waves from washing the banks.

Runs Two Aermotor Grinders and a 12-inch Irrigating Pump at the same time.

ARKANSAS CITY, KAS., July 15, 1895.

AERMOTOR Co., Kansas City, Mo.

Gentlemen. The 12-inch Aermotor irrigating pump is attached to a 16-foot geared Aermotor, and is run by a pump jack about 40 feet from the mill, put in by a well-to-do farmer for a fish pond and for irrigating. He is well pleased with it, and so is every one that sees it run. I have seen the wheel running two grinders, grinding about 40 bushels per hour, and pumping the 12-inch pump full capacity, and not seem to lighten or check the power in the least. It does a person good to watch the expression of pleasure on the faces as they watch the pump roll out the water, which it does in fine shape, I can tell you.

Respectfully,

W. E. MARTIN.

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etc.*

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115 South 11th St., St. Louis, Mo.
Second & Iowa Sts., Sioux City, Ia.
Jones and Main Sts., Dubuque, Ia.
109 East Front St., Davenport, Ia.
131 Second St., Des Moines, Ia.
332 1st. St. North, Minneapolis, Minn.
S. Water St., Ft. Harrison, Peoria, Ill.
185-187 Reed St., Milwaukee, Wis.
Lake Shore Middle Grounds, Toledo, O.
18-20 Ellicott St., Buffalo, N. Y.
65 Park Place, New York, N. Y.
69-71 Pearl St., Boston, Mass.
304 S. Eutaw St., Baltimore, Md.
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STEEL TOWERS, Fixed and Tilting. STEEL
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TANKS, also Cypress and Pine. STEEL FEED
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Do not order a big stock of any of the above articles until the Aermotor Company has given you its bargain price on them. We carry these things in large quantities at your door. We are the price makers of this entire line of goods. You can order them any day of us and get them in one or two days, and save having your place lumbered up with goods you do not yet need. The great saving, however, will be in the price that you will get from us. Address the nearest branch house or AERMOTOR CO. 12th, Rockwell and Fillmore Sts., Chicago.

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machinery is adapted.

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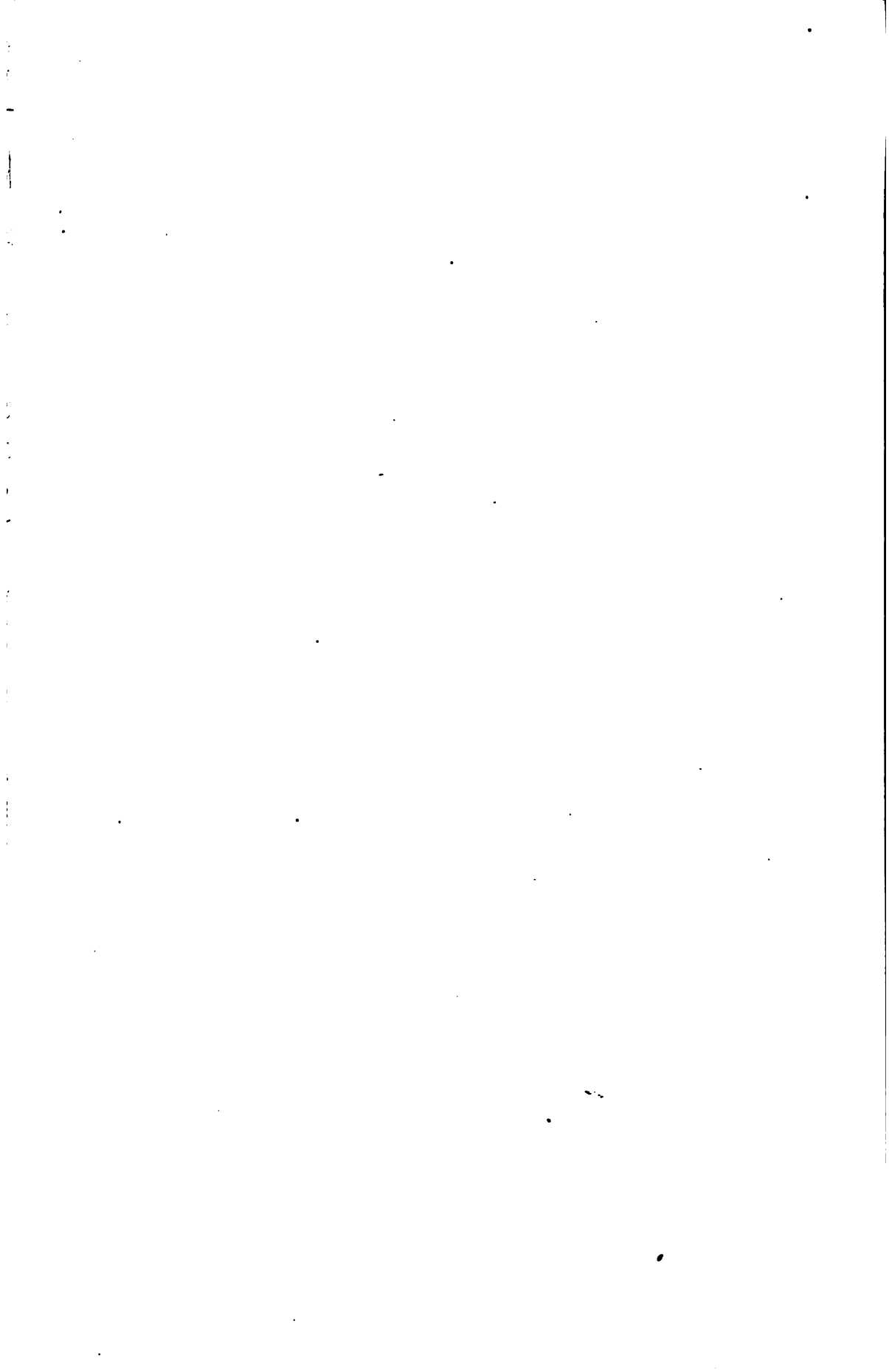
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